ERL

Schlumberger

COMPTEURS
Schlumberger
COMPTEURS SCHLUMBERGER
DEPARTEMENT INSTRUMENTS
5, RUE DAGUERRE 42030 SAINT-ETIENNE
CEDEX FRANCE TEL. (77) 25 22 64
TELEX 330696 CIRCE STETN
ADRESSE TELEGRAPHIQUE : CIRCE ST-ETIENNE

85 MHz

TECHNICAL MANUAL

Oscilloscope

5212

Valable pour commande
-703017-

760210

TABLE OF CONTENTS

			PLATES
P1			Front and rear views
P2			Bottom view Z1
P3			Right side Z2
P4			Left side Z3 - Z4
P5			Circuit board Z1
P6 - P7			Circuit board Z2
P8			Circuit board Z3 and Z4
PAGES			1.- TECHNICAL SPECIFICATION
1	1.1		Introduction
2	1.2		Vertical deflection
3	1.3		Triggering
7	1.4		Horizontal deflection
8	1.5		Cathode ray tube
9	1.6		Calibrator
	1.7		Auxiliary outputs, ⊓ B1 and B2
	1.8		Power requirements
	1.9		Environmental
	1.10		Dimensions - Weight
10	1.11		Accessories
			2.- OPERATION
11	2.1		Preliminary
		2.1.1	Carrying handle
		2.1.2	Switching on
		2.1.3	Operating conditions
12	2.2		Description of controls and input/output terminals
		2.2.1	Power - trace adjustment - calibrator
		2.2.2	Vertical deflection - channels A and B
14		2.2.3	Horizontal deflection
16		2.2.4	Oscilloscope rear panel
17	2.3		Operating instructions
		2.3.1	Initial control positions

Digitized by the Internet Archive
in 2025

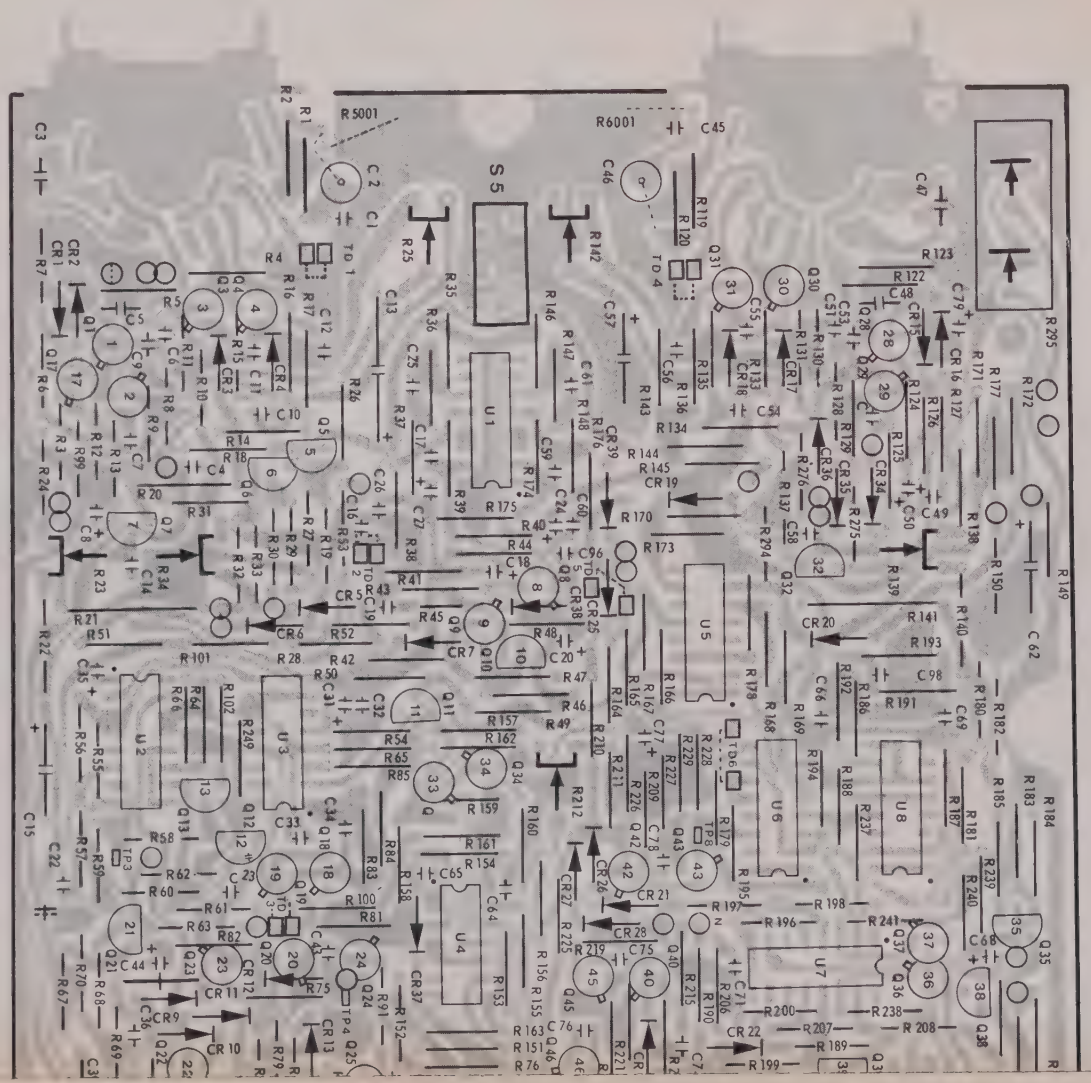
https://archive.org/details/manualsplus_10049

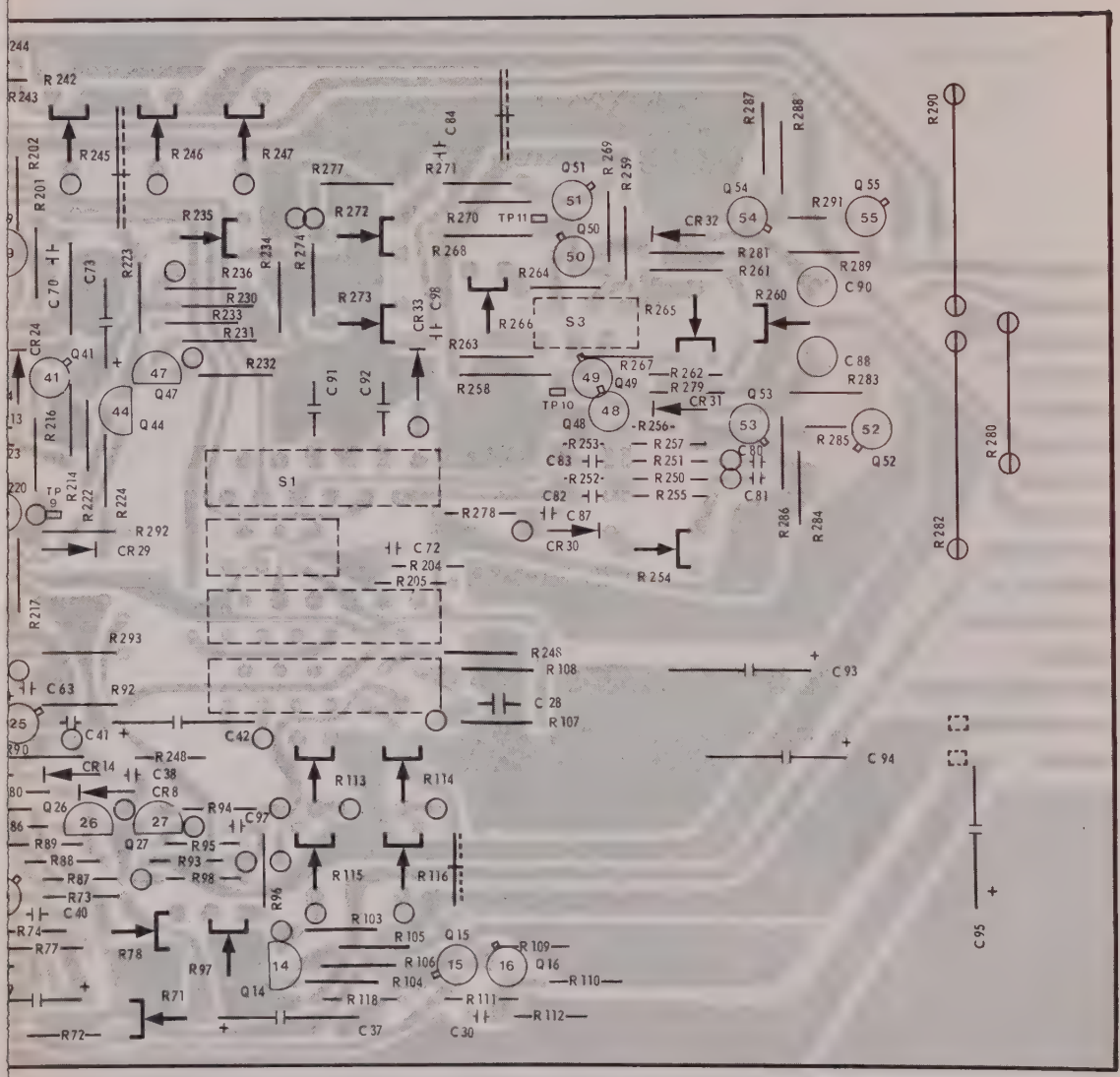
PAGES				
18		2.3.2		Switching on
		2.3.3		Trace adjustment
		2.3.4		Balancing
19		2.3.5		"Alternate" operation
		2.3.6		"Chopped" operation
		2.3.7		Algebraic sum operation (A + B)
20		2.3.8		B1 triggering
21		2.3.9		B2 triggering
		2.3.10		Expansion
		2.3.11		B2 delayed sweep
22		2.3.12		Mixed sweep
		2.3.13		Single sweep
		2.3.14		XY mode
23		2.3.15		External modulation
24	2.4			Trigger mode selection
				3. - CIRCUIT DESCRIPTION
26	3.1			General principles
		3.1.1		Vertical deflection
		3.1.2		Horizontal deflection
27		3.1.3		Z Modulation - Calibrator - General power PCB Z1
	3.2			Y Subassembly - Printed circuit board Z3
		3.2.1		Channel A input
29		3.2.2		Channel B input
		3.2.3		Channel A preamplifier
30		3.2.4		Channel B preamplifier
31		3.2.5		Channel switching control
		3.2.6		Trigger signal viewing
		3.2.7		Output circuit of preamplifiers A and B
32		3.2.8		Vertical amplifier
		3.2.9		Channel switching logic
34		3.2.10		Trigger amplifier
35		3.2.11		Trigger control logic
38	3.3			X Subassembly - Printed circuit board Z2
		3.3.1		Input switches
39		3.3.2		B1 trigger circuit
40		3.3.3		B1 time base
			3.3.3.1	Général
41			3.3.3.2	Miller integrator
42			3.3.3.3	Sweep command

PAGES				
43			3.3.3.4	Hold-off
			3.3.3.5	Fly-back system
44			3.3.3.6	Single sweep
46		3.3.4		B2 Trigger and time base
47			3.3.4.1	Delay circuit
			3.3.4.2	B2 Sweep control
49			3.3.4.3	Fly back to the start point voltage
			3.3.4.4	Bright up
50		3.3.5		Sweep mode selector S4
51		3.3.6		X amplifier
52	3.4			Main chassis-printed circuit board Z3
		3.4.1		Cathode ray tube and EHT converter
53		3.4.2		Bright up amplifier
54		3.4.3		Low voltage power supply
55		3.4.4		Calibrator
	3.5			Description of integrated circuit A250
				4.- MAINTENANCE
56	4.1			Upkeep ofthe front pannel
	4.2			Equipment required for calibration and trouble-shooting
57	4.3			Dismantling
		4.3.1		Removal of the covers
58		4.3.2		Removal of the carrying handle
		4.3.3		Removal of the X subassembly
		4.3.4		Removal of the Y subassembly
59		4.3.5		Removal of the power supply circuit board Z1
		4.3.6		Removal of the CRT
	4.4			Trouble-shooting
60		4.4.1		Lamps and cathode ray tube extinguished
66	4.5			Setting up
		4.5.1		Low voltage power supplies
		4.5.2		HT power supply
		4.5.3		Cathode ray tube
69		4.5.4		X amplifier
70		4.5.5		B1 - Triggering
71		4.5.6		B2 - Triggering
		4.5.7		Bright up amplifier
72		4.5.8		B1 time base

PAGES		
73	4.5.9	B2 time base
	4.5.10	Time base linearity
74	4.5.11	Channel A and B balancing
75	4.5.12	Channel A and B gain
	4.5.13	"Trigger view" circuit
76	4.5.14	XY Mode
	4.5.15	Frequency correction of vertical preamplifiers
78	4.5.16	Frequency correction in XY Mode
	4.5.17	Attenuators
79	4.5.18	Auxiliary input and output signal checks
FIG.		5. - CIRCUIT DIAGRAMS
1		Interconnection
2		Power supply
3		EHT power supply bright-up
4		A and B preamplifiers
4 bis		Switching logic - Trigger AMP - Y output AMP
5		B1 Trigger - B1 time base
6		B2 Trigger - B2 time base
7		X amplifier - X mode switch

CIRCUIT IMPRIME Z2
CIRCUIT BOARD Z2




R 242
R 245
R 246
R 247
R 277
R 271
C 84
Q 51
R 269
R 259
R 287
R 288
R 290
Q 54
Q 55
R 291
R 235
R 272
R 270
TP 11
R 268
Q 50
CR 32
R 281
R 261
R 289
C 90
R 236
R 234
R 274
R 264
R 230
R 273
R 266
S 3
R 265
R 260
R 233
C 98
CR 33
R 263
R 231
R 232
C 88
R 283
C 91
C 92
R 258
TP 10
Q 48
R 256
R 253
R 252
C 83
C 82
R 278
C 87
CR 30
R 254
R 257
R 251
R 250
R 255
Q 53
R 285
Q 52
C 80
C 81
R 286
R 284
R 280
R 282
S 1
C 72
R 204
R 205
R 293
R 248
R 108
C 93
C 63
R 92
C 28
R 107
C 41
C 42
C 94
R 248
CR 14
C 38
CR 8
R 113
R 114
Q 26
Q 27
R 94
C 97
R 89
R 95
R 88
R 93
R 87
R 98
R 73
R 115
R 116
R 96
C 40
R 74
R 103
R 77
R 78
R 105
Q 15
R 109
R 97
R 106
R 110
Q 14
R 104
R 118
R 111
R 71
R 112
R 72
C 37
C 30
C 95

ate le 10. 9. 75 | Dessiné par

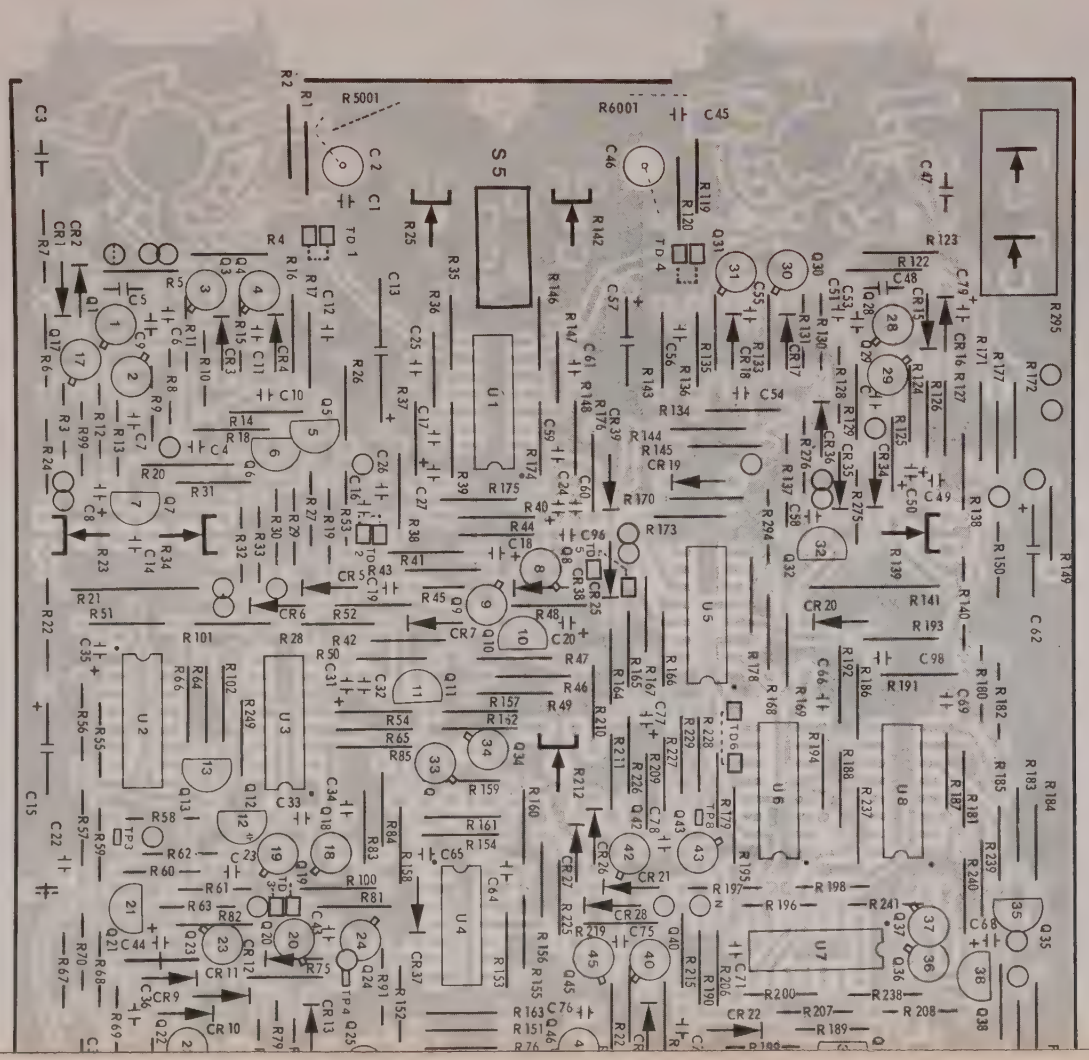
Commandes exécutées

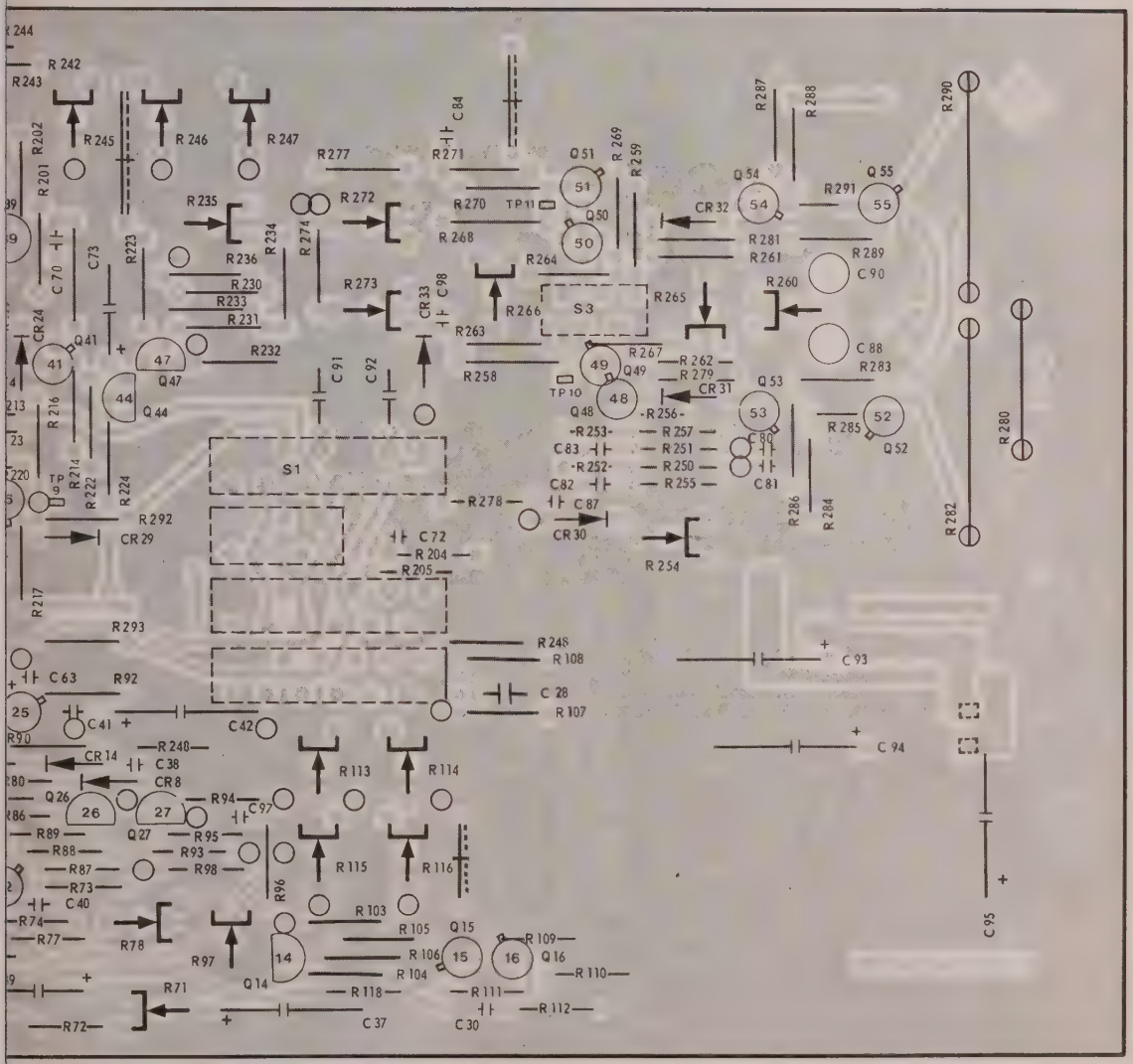
de nº | App. nº

Schlumberger

Référence 5212

CIRCUIT IMPRIME Z2
CIRCUIT BOARD Z2




R 244
R 242
R 243
R 245
R 246
R 247
R 202
R 201
C 84
R 277
R 271
Q 51
R 269
R 259
R 287
R 288
R 290
Q 54
Q 55
R 291
R 235
R 272
R 270
TP 11
Q 50
CR 32
R 268
R 264
R 281
R 261
R 289
C 90
R 236
R 234
R 274
R 223
C 70
C 73
R 230
R 233
R 231
R 273
CR 33
C 98
R 266
S 3
R 265
R 260
CR 24
Q 41
R 263
R 232
R 267
R 262
R 279
C 88
R 283
C 91
C 92
R 258
TP 10
Q 49
CR 31
Q 53
R 216
R 214
R 222
R 224
Q 48
R 256
R 253
R 257
R 285
R 280
Q 52
C 83
R 251
C 80
S 1
R 252
R 250
C 82
R 255
C 81
R 278
C 87
R 286
R 284
R 292
CR 29
C 72
CR 30
R 254
R 282
R 204
R 205
R 217
R 293
R 248
C 93
C 63
R 92
R 108
C 28
C 41
C 42
R 107
C 94
R 240
CR 14
C 38
R 113
R 114
CR 8
R 94
C 97
R 89
R 95
R 88
R 93
R 87
R 98
R 115
R 116
R 96
R 73
C 40
C 95
R 74
R 103
R 77
R 78
R 105
Q 15
R 109
R 97
R 106
Q 16
R 104
R 110
R 71
Q 14
R 118
R 111
R 72
C 37
C 30
R 112

le 10.9.75 | Dessiné par Baumlay

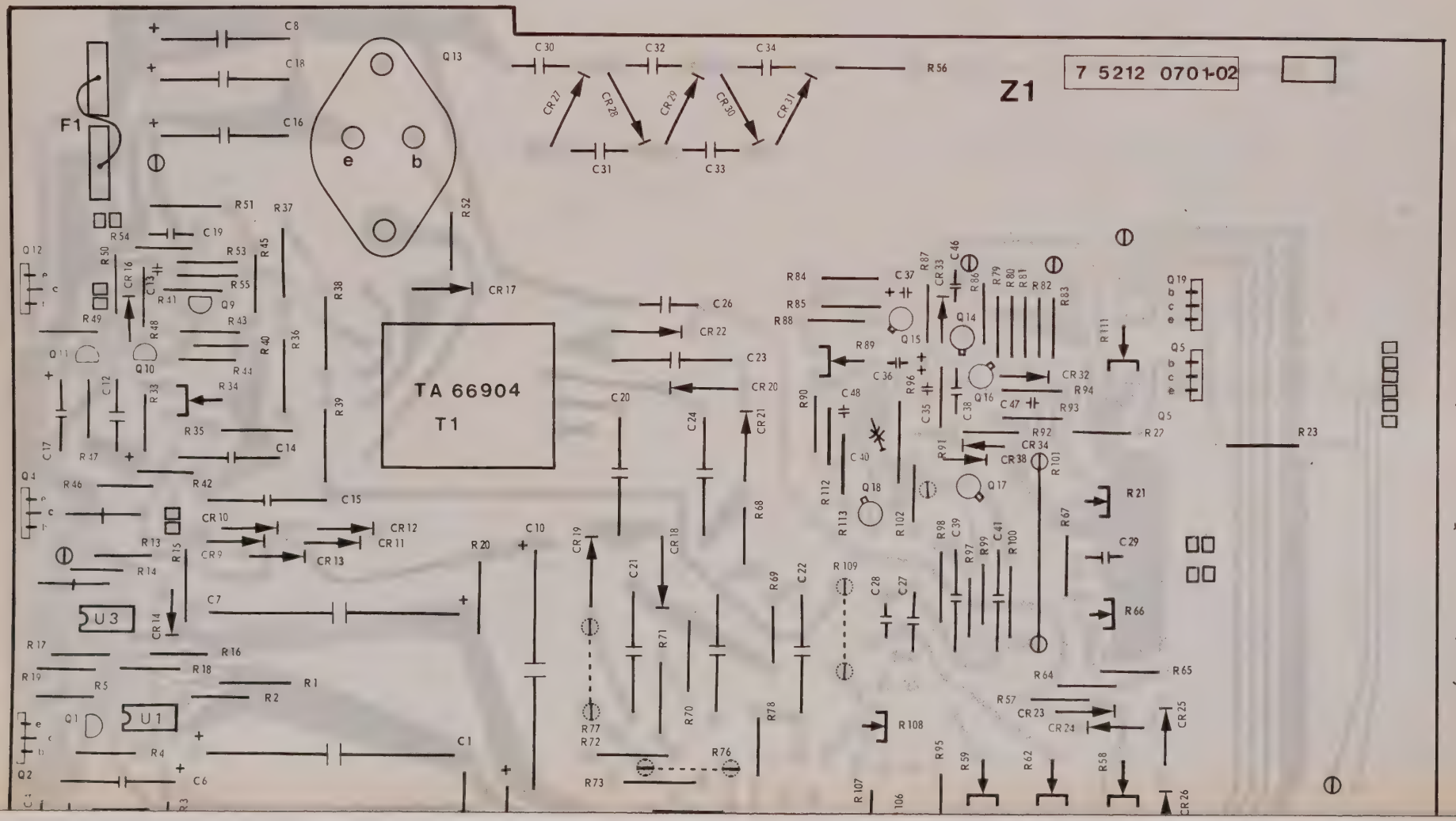
Commandes exécutées

n° | App. n°

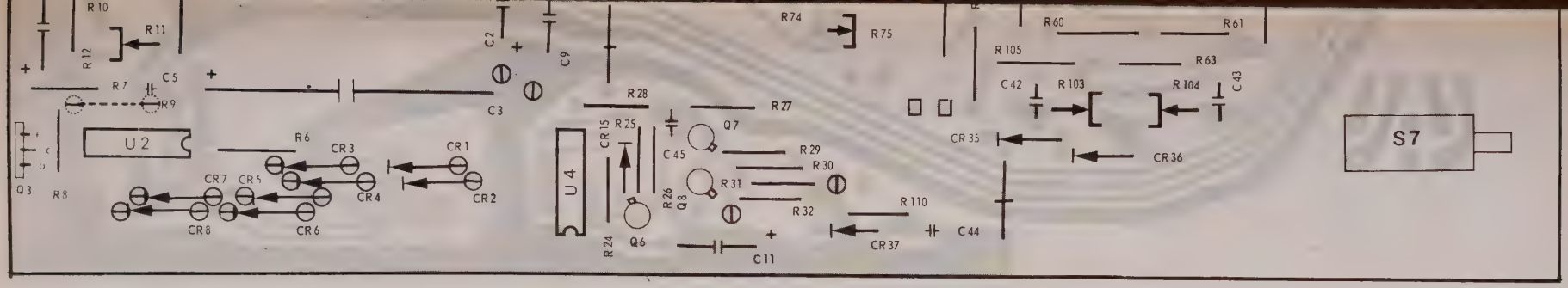
Schlumberger

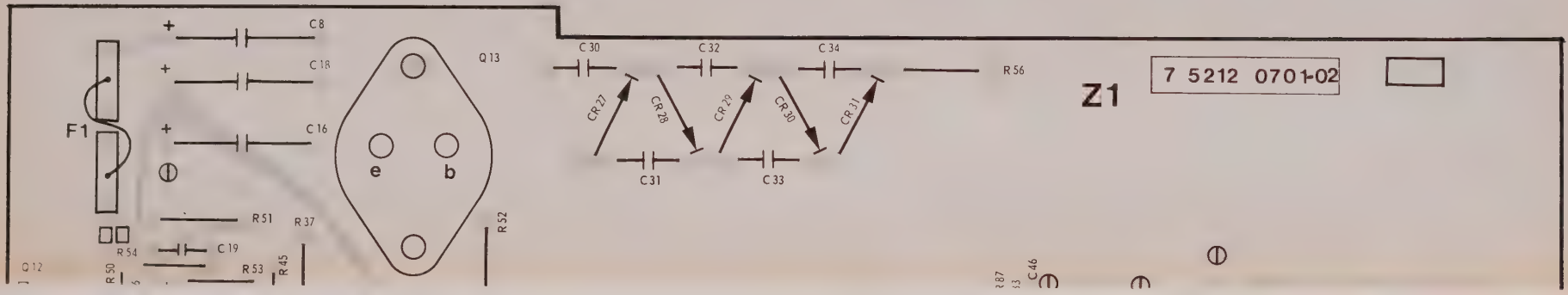
Référence 5212

Cuivre : Coté extérieur - Repères vue coté soudures



Cuivre : coté extérieur - Repères vus coté composants


R10
R11
R12
C2
C9
R74
R75
R60
R61
R105
R63
C42
R103
R104
C43
R7
C5
R9
C3
R28
R27
U2
R6
CR3
CR1
CR7
CR5
CR4
CR2
CR8
CR6
Q3
R8
CR15
R25
Q7
C45
R29
R30
U4
R26
Q8
R31
R32
R24
Q6
C11
R110
CR37
C44
CR35
CR36
S7


C8
C18
C16
F1
Q13
e
b
C30
C32
C34
R56
CR27
CR28
CR29
CR30
CR31
C31
C33
Z1
7 5212 0701-02
R51
R37
R54
C19
R53
R45
R50
R52
Q12
C46

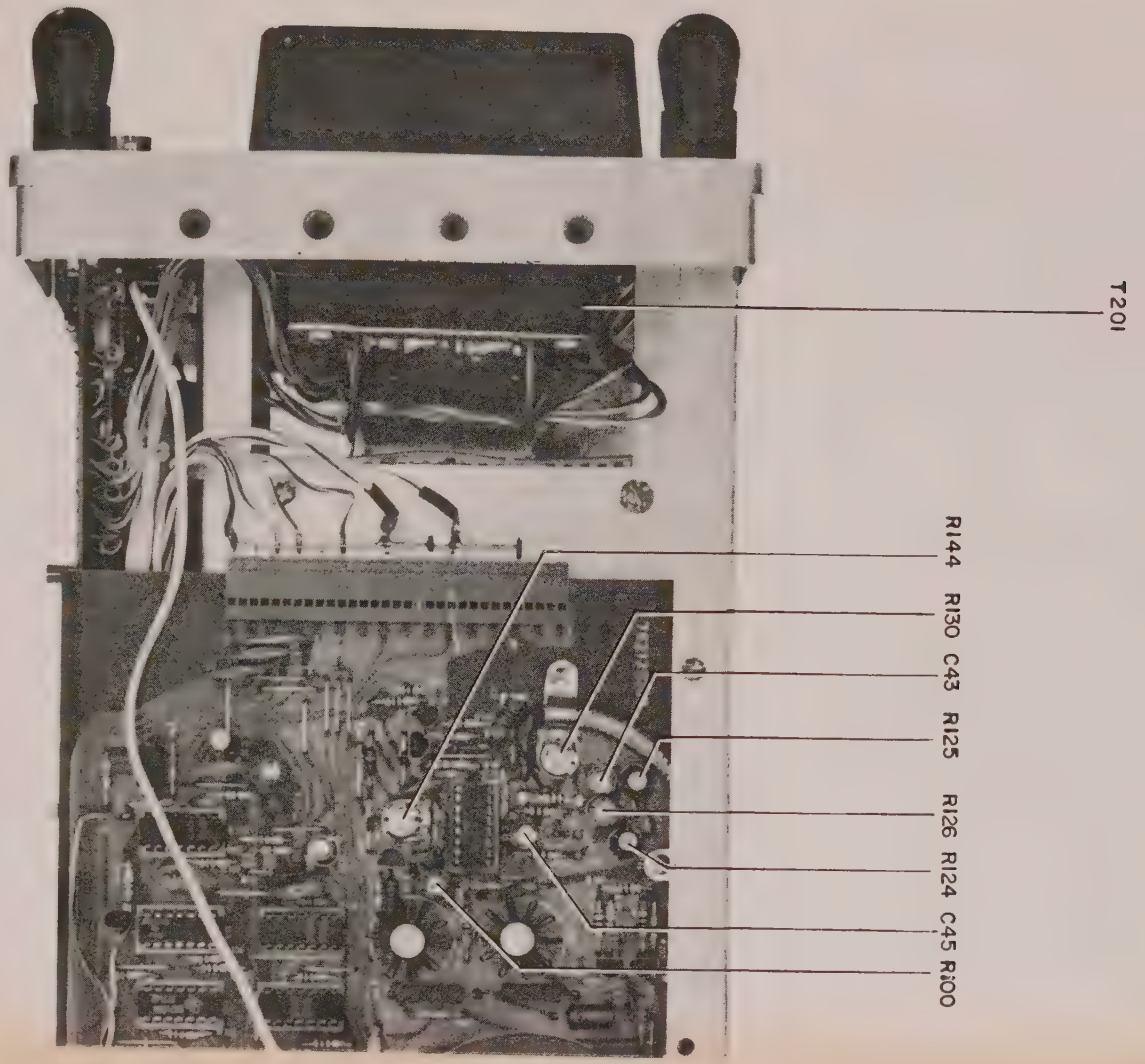
CIRCUIT IMPRIME Z1
CIRCUIT BOARD Z1

P5

5212 4615

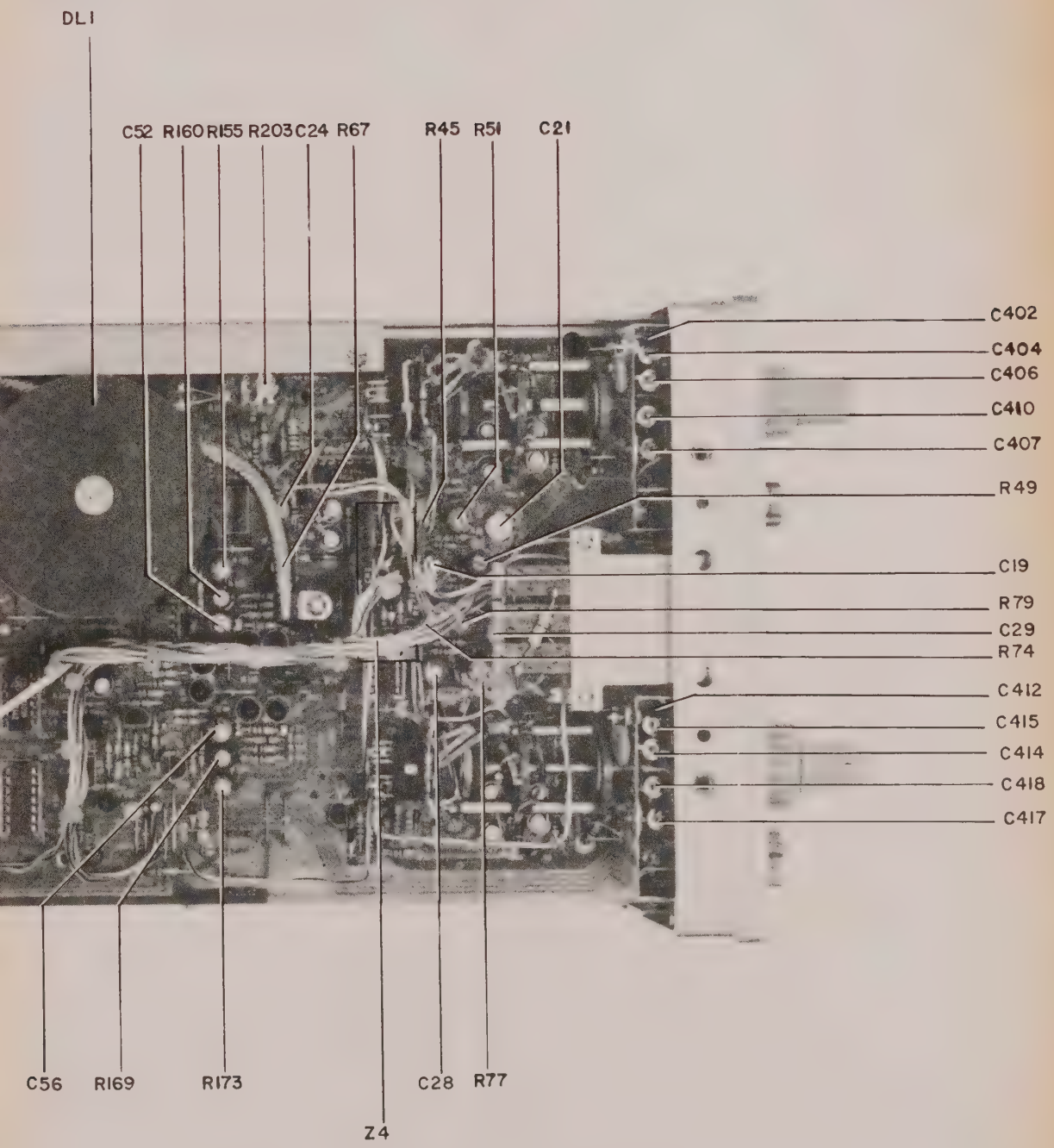
Cuivre : coté intérieur - Repères vus coté composants

COTE GAUCHE Z3-Z4
LEFT SIDE Z3-Z4



Ligne a retard

Delay line



Date le 24 Septembre 75 | Dessiné par J. Bernigaud

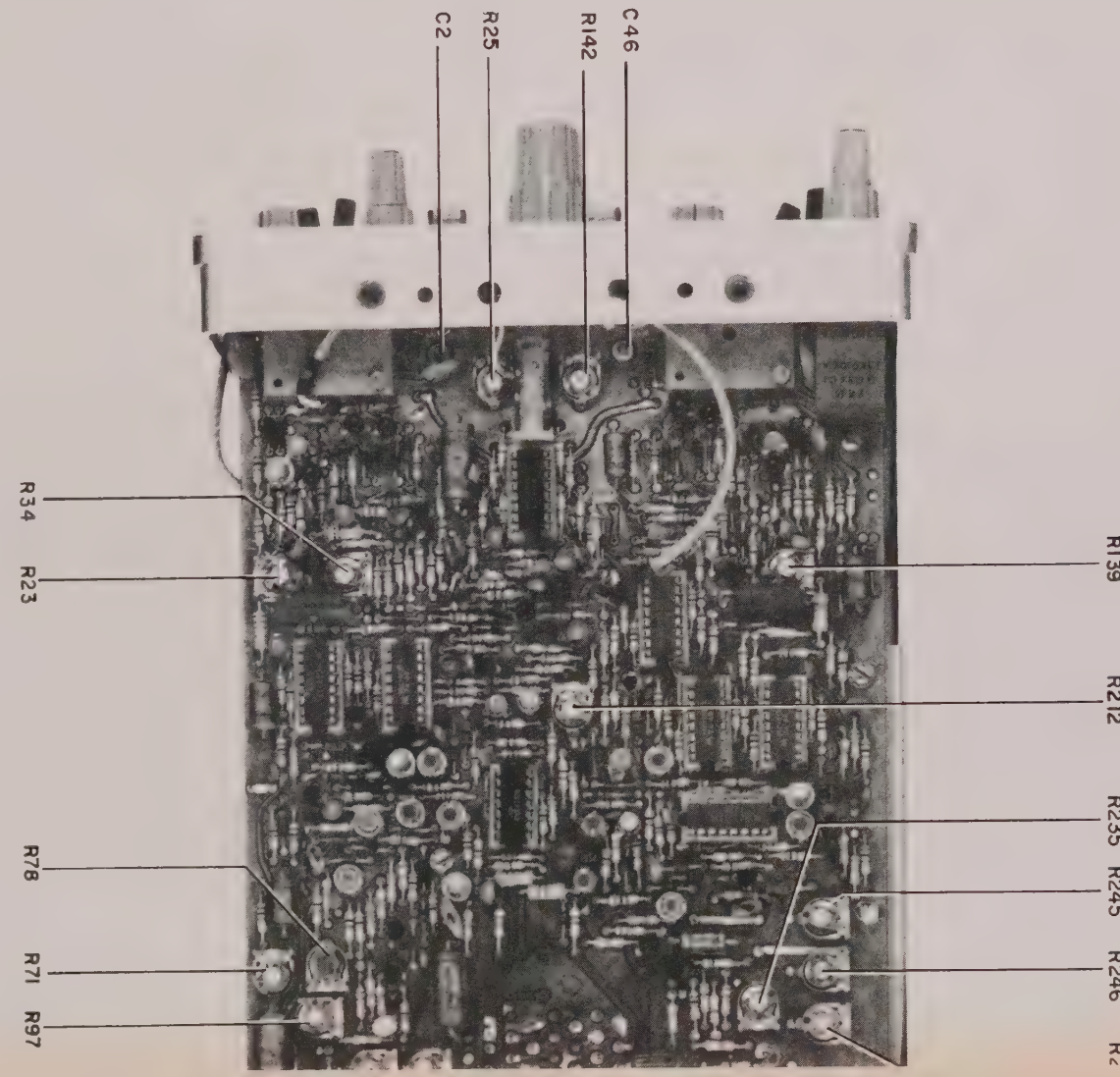
Commandes exécutées

Cde nº | App. nº

Schlumberger

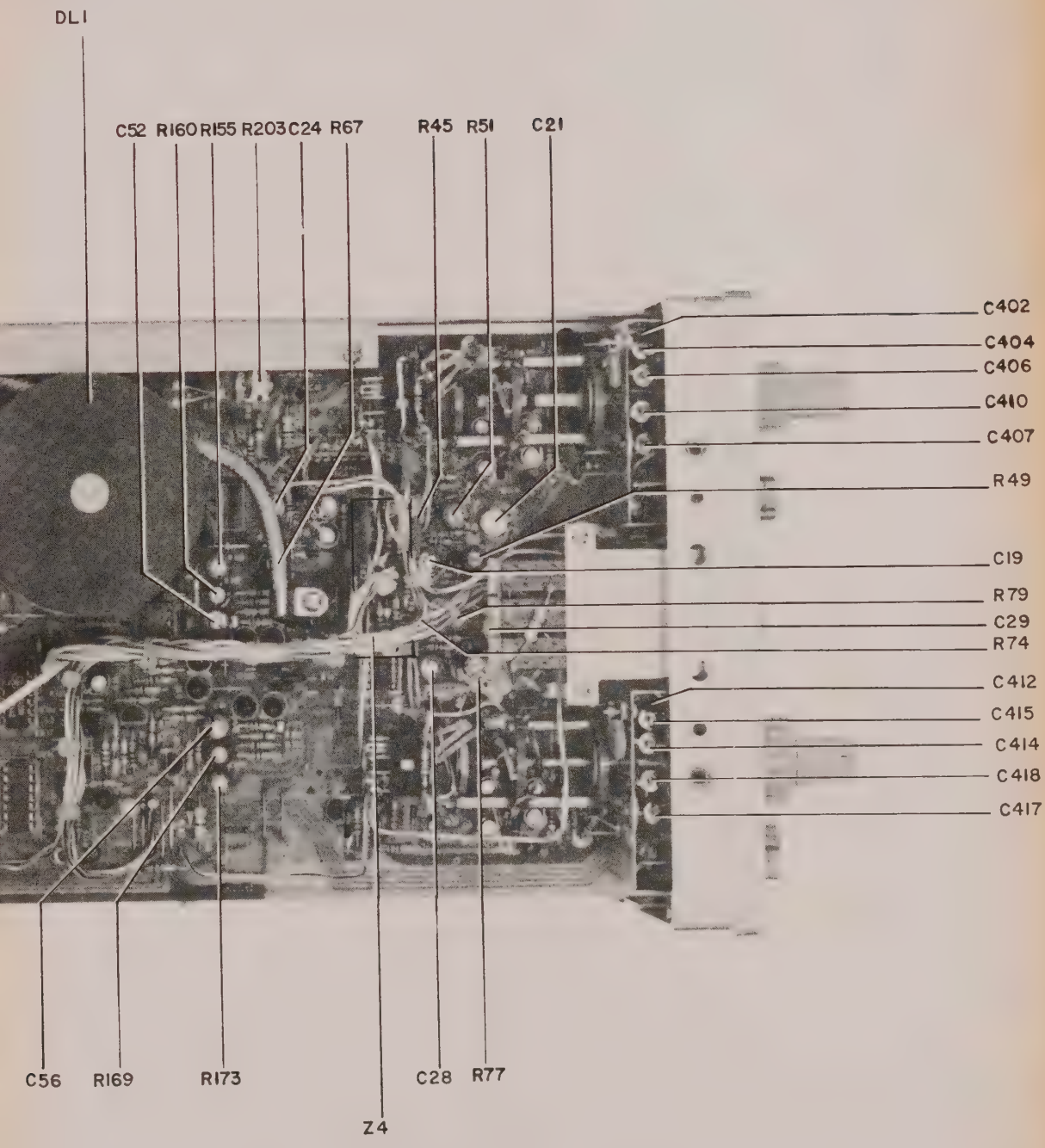
Référence 5212

COTE DROIT Z2
RIGHT SIDE Z2



Ligne a retard

Delay line



ate le 24 Septembre 75 | Dessiné par J. Barriefond

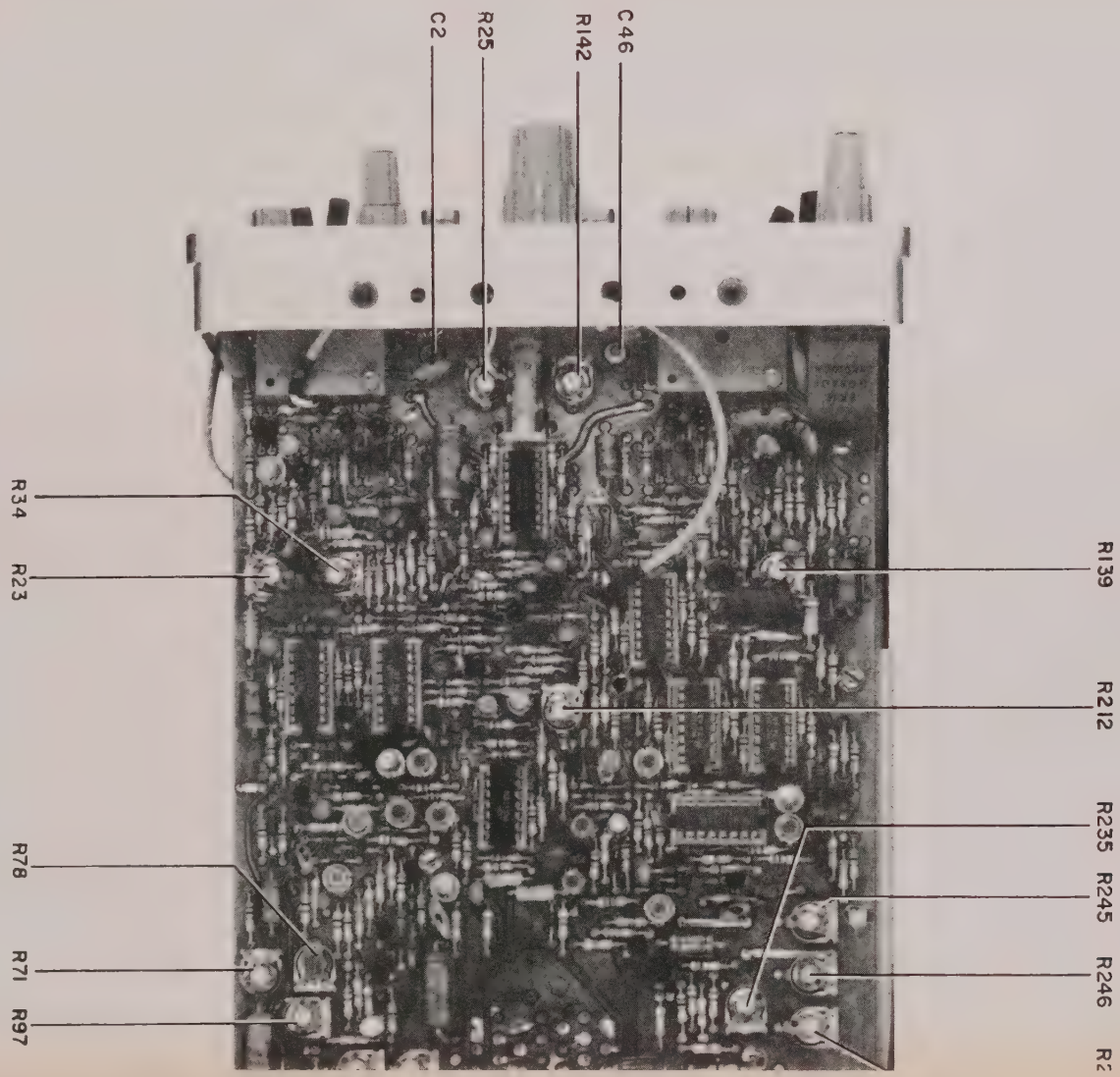
Commandes exécutées

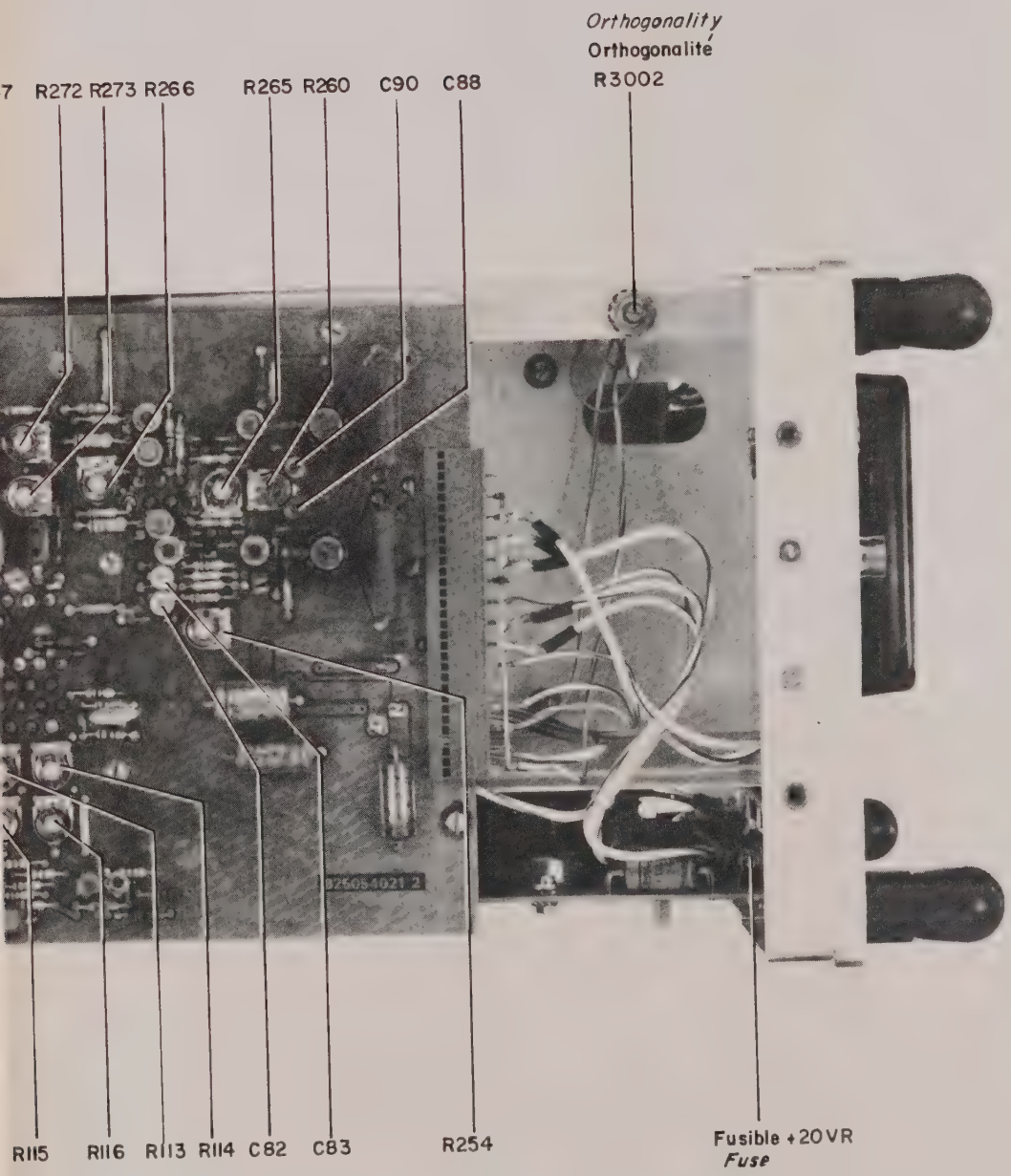
de n° | App. n°

Schlumberger

Référence 5212

COTE DROIT Z2
RIGHT SIDE Z2




7
R272
R273
R266
R265
R260
C90
C88
Orthogonality
Orthogonalité
R3002
R115
R116
R113
R114
C82
C83
R254
Fusible +20VR
Fuse

te le 24-Septembre 75 | Dessiné par Baumeyer

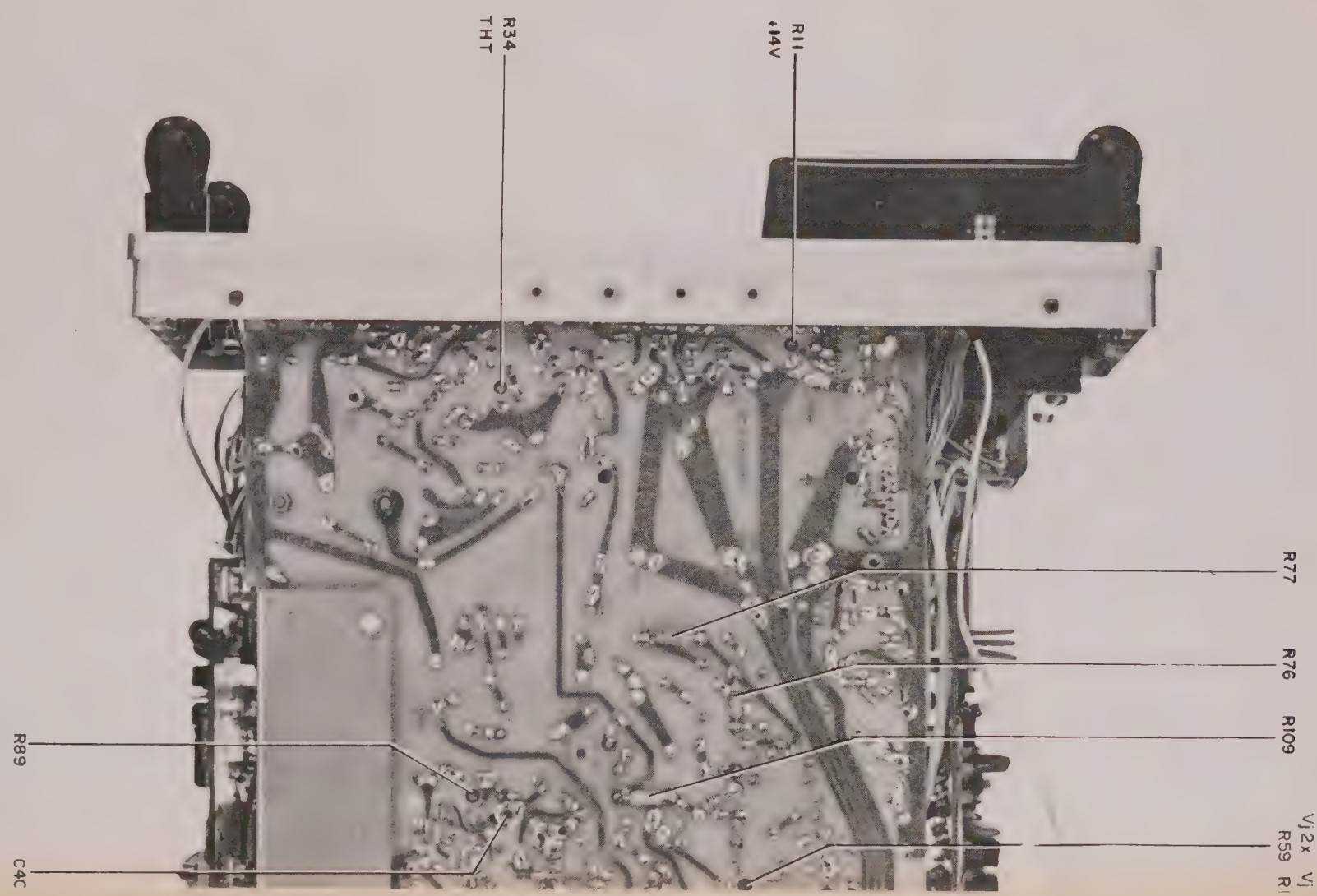
Commandes exécutées

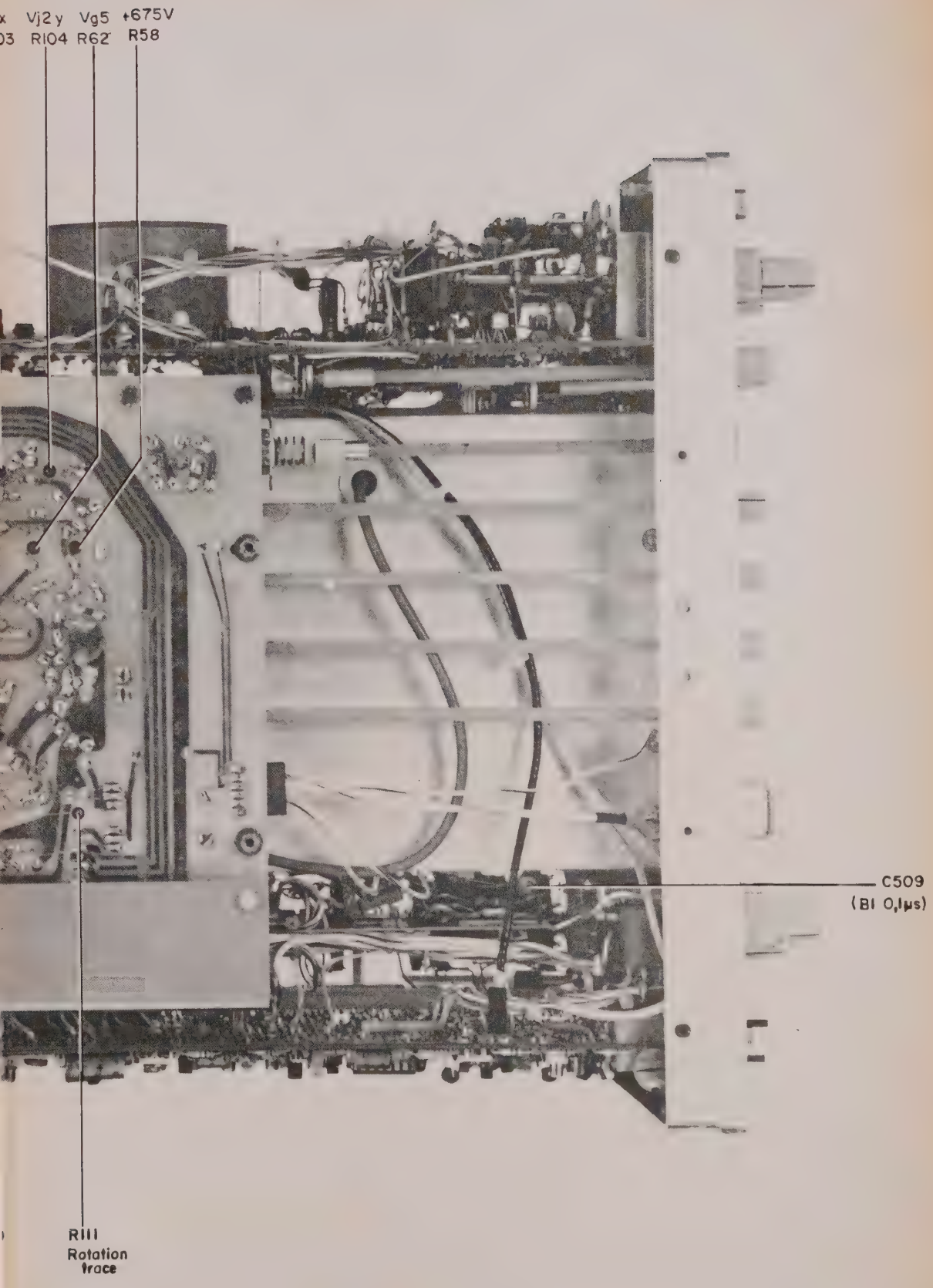
e nº | App. nº

Schlumberger

Référence 5212

VUE DE DESSOUS ZI
BOTTOM VIEW ZI




x Vj2y Vg5 +675V
03 R104 R62 R58
C509
(BI 0,1µs)
R111
Rotation
trace

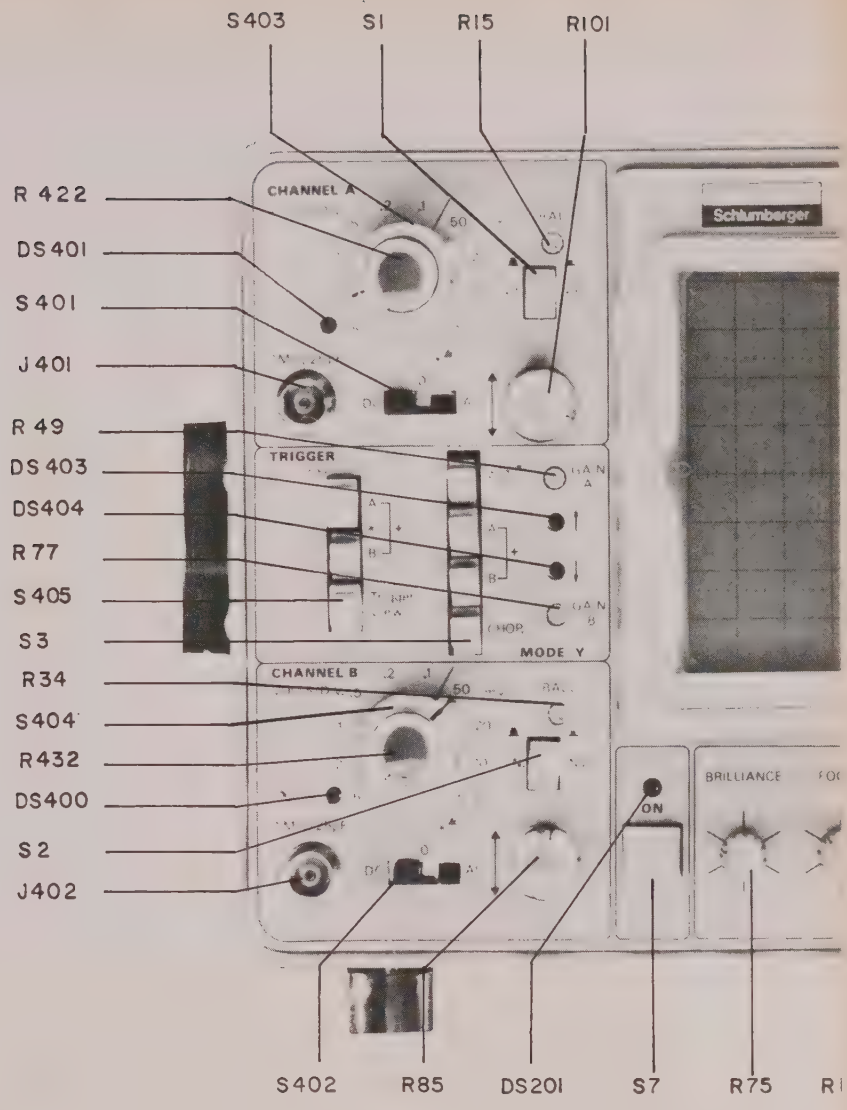
Date le 24 - Septembre 75	Dessiné par J. Bourne

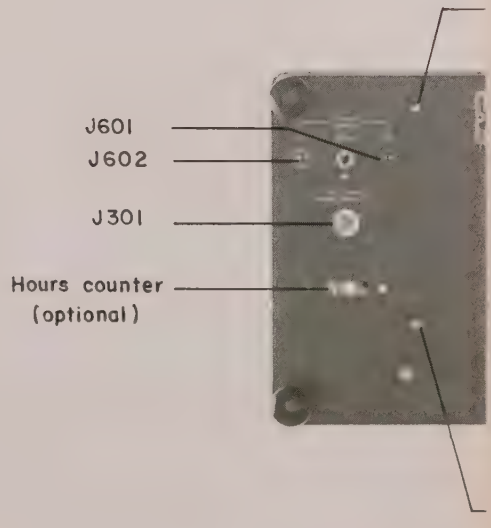
Commandes exécutées

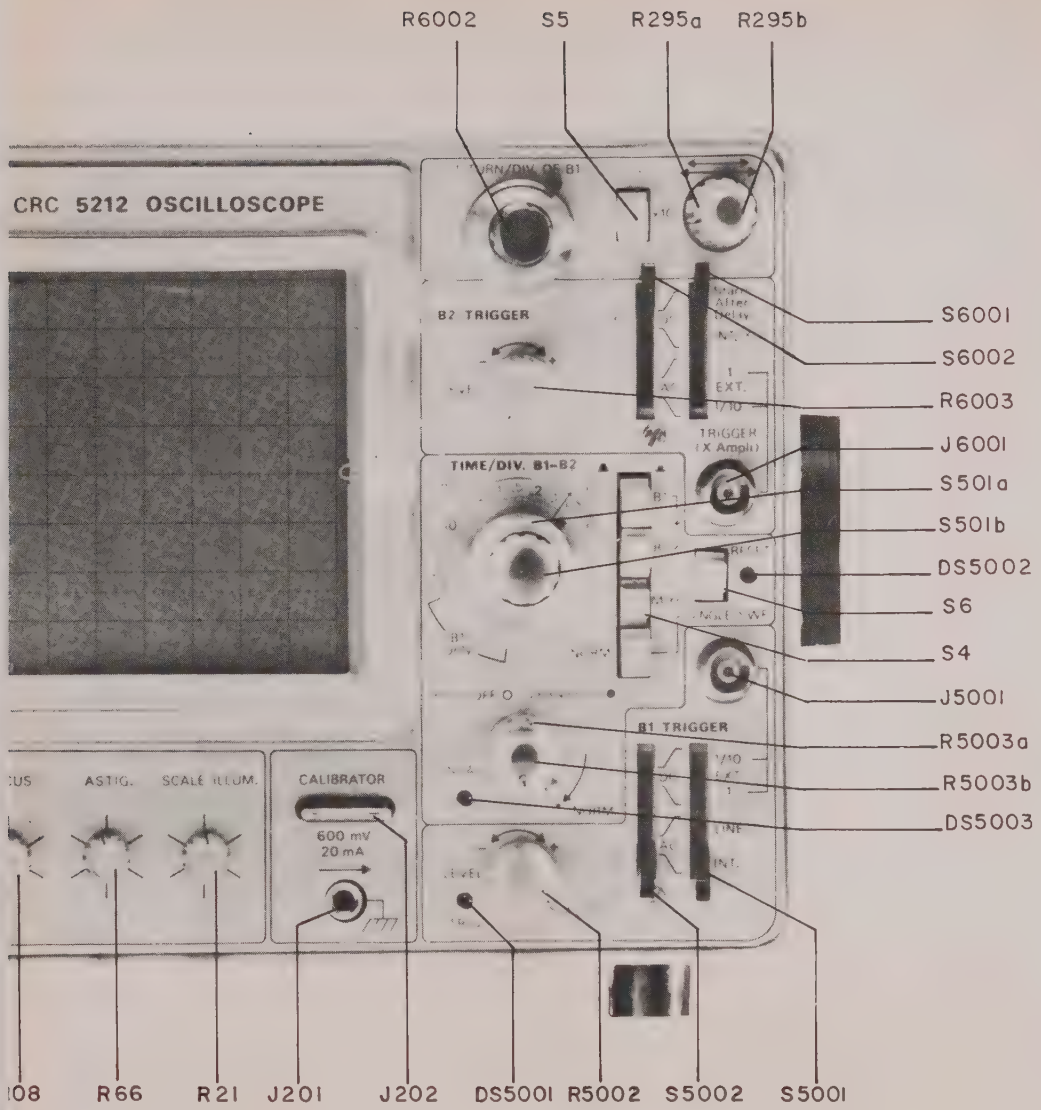
Cde n°	App. n°

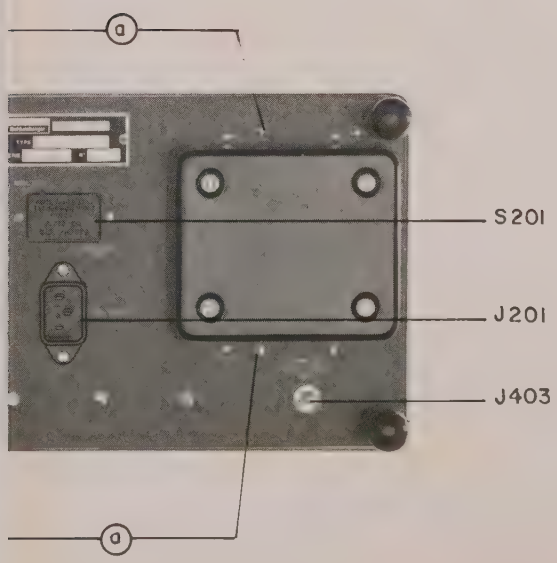
Schlumberger

Référence 5212


S403
S1
R15
R101
R 422
DS401
S 401
J401
R 49
DS 403
DS404
R 77
S 405
S3
R34
S404
R432
DS400
S2
J402
CHANNEL A
TRIGGER
MODE Y
CHANNEL B
Schlumberger
BRILLIANCE
ON
S402
R85
DS201
S7
R75


J601
J602
J301
Hours counter
(optional)


R6002
S5
R295a
R295b
CRC 5212 OSCILLOSCOPE
B2 TRIGGER
TIME/DIV. B1-B2
B1 TRIGGER
TRIGGER (X Ampli)
CALIBRATOR
600 mV
20 mA
ASTIG.
S6001
S6002
R6003
J6001
S501a
S501b
DS5002
S6
S4
J5001
R5003a
R5003b
DS5003
R66
R21
J201
J202
DS5001
R5002
S5002
S5001


a
S201
J201
J403
a

e le 19-12-1978 | Dessiné par Mme Bourdy

Commandes exécutées

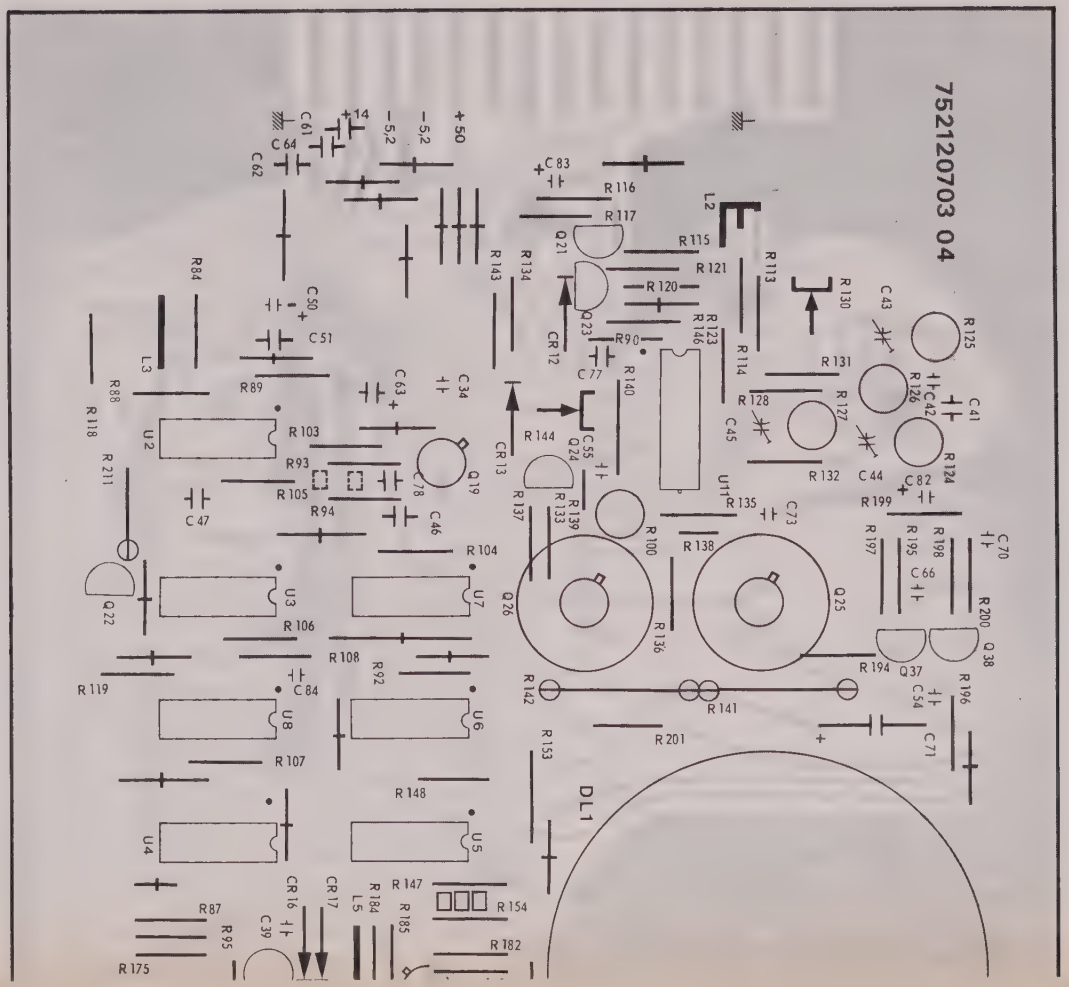
nº | App. nº

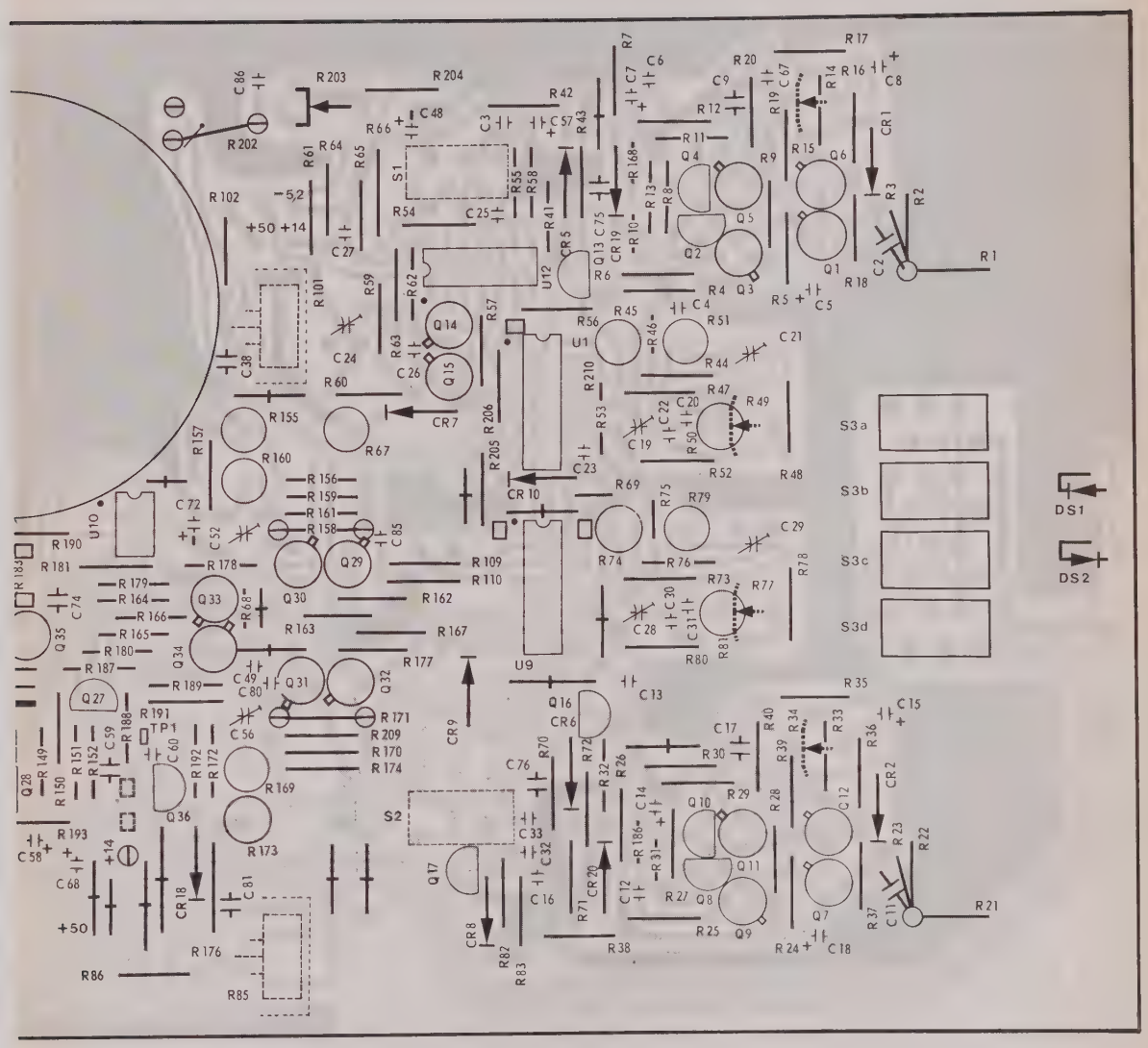
COMPTEURS

Schlumberger

Référence 5212

CIRCUIT IMPRIME Z3 et Z4
CIRCUIT BOARD Z3 AND Z4




S3a
S3b
S3c
S3d
DS1
DS2
S1
S2
TP1
U1
U9
U10
U12
752120704
CR2
Q2
C1
C2
C3
R1
R2
R3
R4
R5
R6
R7
+14

Date le 10-975 | Dessiné par A Bamberg

Commandes exécutées

Cde nº | App. nº

Schlumberger

Référence 5212

1.-TECHNICAL SPECIFICATION

1.1-INTRODUCTION

The CRC 5212 oscilloscope has a bandwidth of 85 MHz, a dual time base, and two independent vertical channels.

Extensive use is made of integrated circuits, and the whole instrument is designed for reliability, low cost, light weight and compactness, and for ease of maintenance.

Basically the unit consists of three printed circuit cards mounted on either side of and below the cathode ray tube, on a light alloy girder which also protects the tube. These circuit boards carry the X and Y functions and the power supply, respectively.

The cathode ray tube features quadripole lenses, and has very high definition and brilliance. The writing speed goes up to 2 cm/ns, and there is no halation.

The two vertical channels have 5 mV/div. sensitivity up to 85 MH In addition, channel A can operate to 1 mV/div., with bandwidth reduced to 15 MHz. The two channels can be used separately, or together in "alternate" or "chopped" modes. One of the channels can be inverted to give algebraic addition.

The dual time base (B1 and B2) is capable of the following sweep modes : B1 only, B1 delaying and intensified by B2, B2 delayed only, B1 and B2 mixed. The fastest sweep rate is 10ns/div., with triggering up to 85 MHz.

Operation is simplified by numerous front panel lamps for indicating that verniers are switched in, the direction in which the trace is off-screen, that the unit is ready for resetting in "single sweep" mode, and that the signal is synchronized. A push-button is provided so that the external trigger signal can be displayed.

The performance of the CRC 5212 makes it suitable in particular for viewing fast, low repetition rate signals; the instrument performs equally well in the laboratory and in field servicing.

1.2.- VERTICAL DEFLECTION

Two amplifier channels, A and B.

- Sensitivity (1 div. = 1 cm)
  - . ranges: 5 mV to 5 V/div.
  - . attenuator: 10 calibrated positions, in 1-2-5 sequence
  - . calibration accuracy: ± 3 %
  - . vernier: continuously variable between all ranges, with ratio ≥ 2.5 : 1
  - . lamp indicates when vernier is not in CAL. position
  - . x 5 multiplication of channel A gain, extending sensitivity to 1 mV/div.

- Bandwidth to upper - 3 dB point, calculated rise time

sensitivity	5 mV to 5 V/div.	1 mV/div.
bandwidth	85 MHz	15 MHz
rise time (calculated)	4 ns	23 ns
pulse irregularities	≤ [illegible] % in the first 50 ns ≤ 2 % afterwards	

- Bandwidth to lower - 3 dB point: 2 Hz (with input selector in AC position)

- Input coupling selection

  DC: direct coupling
  0 : input connector disconnected, amplifier input grounded
  AC: DC component of the signal blocked

- Input impedance

  1 megohm paralleled by 22 pF ± 2 pF

- Maximum permissible input voltage

  250 V DC (including peaks of superimposed signals)
  500 V AC peak to peak

- Operating modes
  - . channel A only
  - . channel B only
  - . sweep-alternate switching of channels A and B
  - . chopping at fixed frequency (approx. 500kHz) of channels A and B
  - . algebraic sum A ± B of signals applied to the two channels
- Visible delay of delay line: 40 ns approx.
- Vertical signal output
  - . amplitude: 25 mV/div. approx (DC level is dependent on vertical position of trace)
  - . bandwidth: DC to 30 MHz
  - . output impedance: 50 ohms approx.
- Off-screen indication by lamps showing the direction in which the trace is off-screen.
- Inter-channel crosstalk: 40 dB from DC to 30 MHz.

1.3.- TRIGGERING

- Source
  - . internal: . channel A
    - . channel B
    - . channels A and B alternately
    - . channels A and B mixed
  - . line frequency (B1 trigger only)
  - . external: on signals applied to corresponding inputs, with or without 1/10 attenuation
- External trigger input
  - . minimum input voltage: 100 mV
  - . maximum input voltage: 250 V DC (including peaks of superimposed signals)
    - 500 V AC peak to peak
  - . level: continuously variable from + 1.25 V to - 1.25 V (from + 12.5 V to - 12.5 V with 1/10 attenuation)
  - . input impendance: 1 megohm paralleled by approx. 35 pF
- Display of external trigger signal with sensitivity of approx. 50 mV/div.
- Indicator lamp shows triggering is attained
- Coupling: DC or AC (signals below 2 Hz blocked)
- Level and slope: selection of rising or falling slope of signal, with adjustment of trigger level.

- B1 trigger modes

  . Automatic (with AC coupling only):

    . B1 sweep free-runs in absence of input signal

    . triggering at a fixed level on all signals between 50 Hz and 85 MHz. The level is the mean value of the signal. Pulse trains should have a duty cycle of greater than 1/10.

  . Normal: triggering from DC to 85 MHz, with adjustment of level.

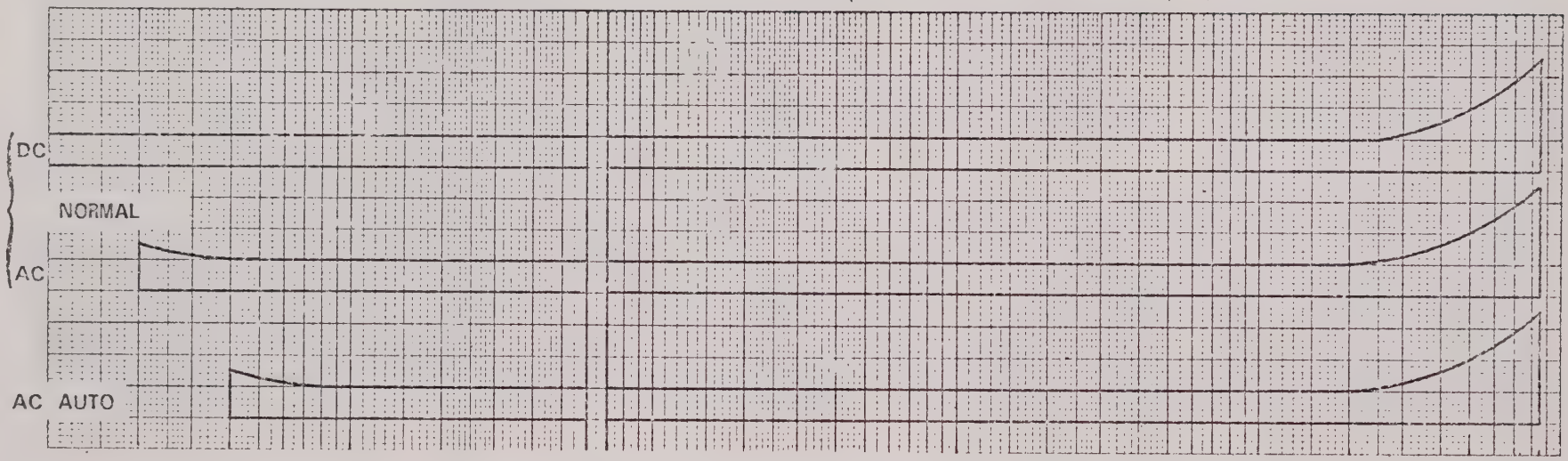
- B2 trigger modes (DC to 85 MHz)

  . Starts after delay selected with delay controls

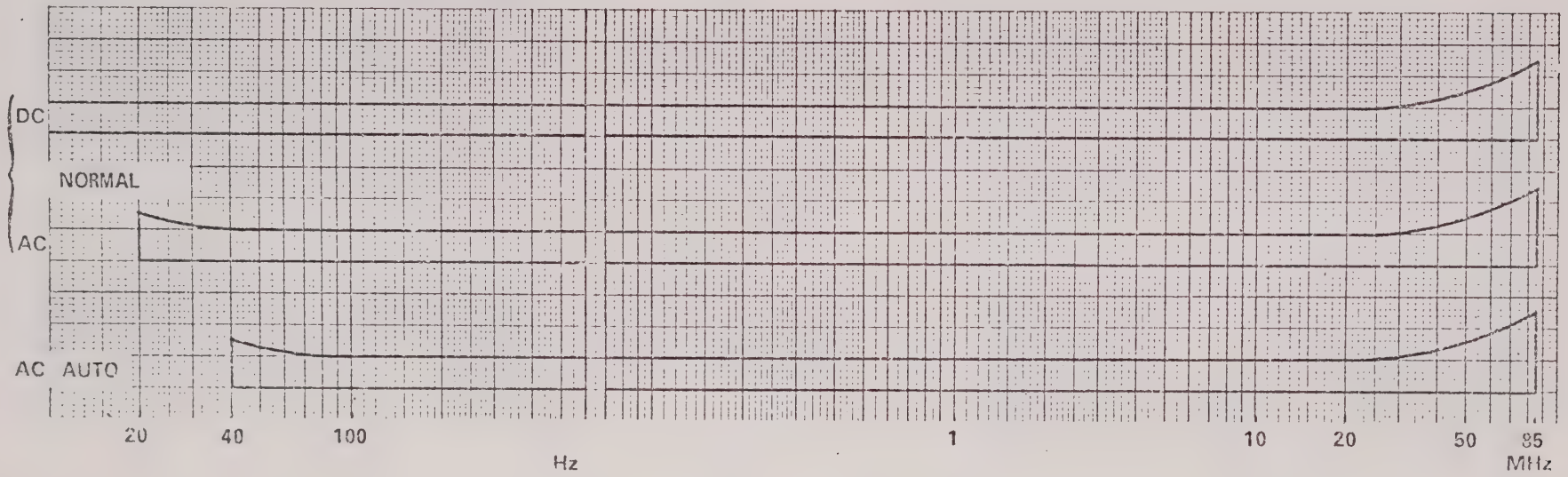
  . Internal: B2 is re-triggered after selected delay, when level set on selected slope is reached.

- Signal levels required for triggering: see tables, pages 5 and 6.

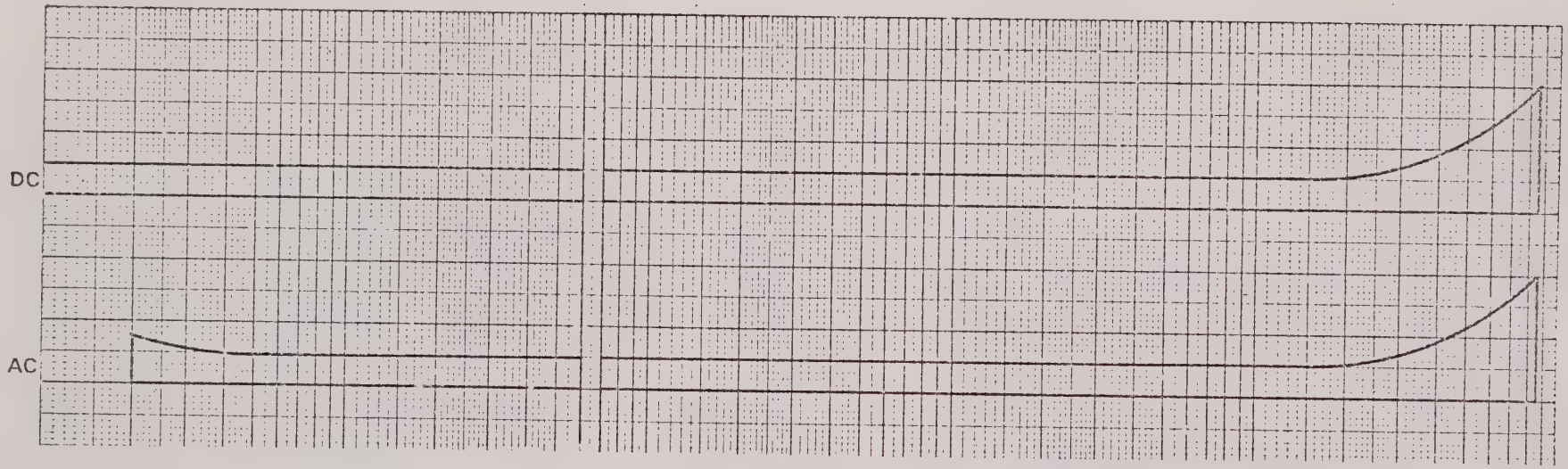
INTERNAL 1 small division = 1 mm on screen scale



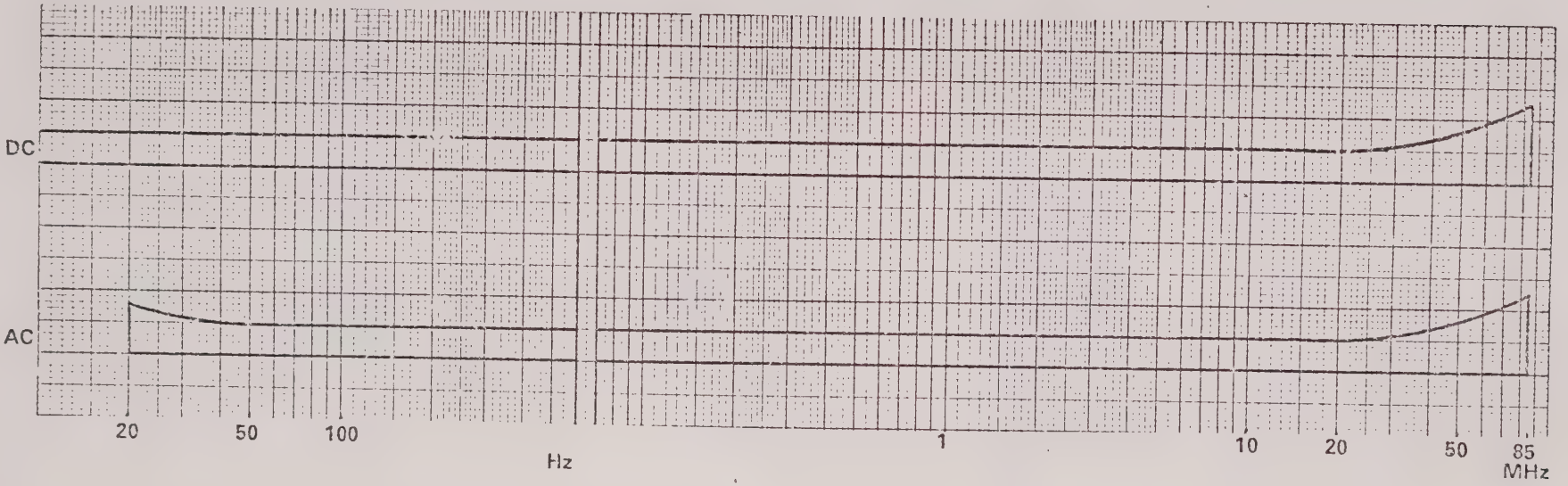
EXTERNAL 1 small division = 20 mV peak to peak



INTERNAL 1 small division = 1 mm on the screen scale



EXTERNAL 1 small division = 20 mV peak to peak



1.4.- HORIZONTAL DEFLECTION

Main time base: B1

Delayed time base: B2

- Sweep rates

  - B1: 100 ns/div. to 1 s/div. in 22 ranges, 1-2-5 sequence
  - B2: 100 ns/div. to 0.1 s/div. in 19 ranges, 1-2-5 sequence
  - x 10 expansion extends fastest sweep rate to 10 ns/div.
  - calibration accuracy of B1 and B2:

    ± 3 % from 100 ns to 0.1 s/div. } except for first
    ± 5 % from 0.2 s to 1 s/div. } and last 50 ns

    with x 10 expansion: add ± 2 % to figure for x 1 (except for first and last 50 ns)
  - vernier: continuously for all ranges, ratio ≥ 2.5 : 1 (B1 only)
  - UNCAL lamp to indicate vernier in use

- Delay system

  - delay: 100 ns to 25 s
  - setting by 10-turn control: 1 turn = 1 division of scale
  - accuracy: ± 2 % of B1 sweep rate
  - jitter: 1/20 000 of total duration of B1 sweep

- Operating modes

  - B1 only
  - B1 delays B2, with B2 intensifying B1
  - B2 only, delayed by B1
  - B1 and B2 mixed
  - horizontal amplifier
  - single sweep available in all operating modes (lamp lights to indicate that the sweep can be reset)
  - trigger hold-off: adjustable, for use when triggering on complex signals.

XY mode (measurements taken over 6 divisions)

X deflection source	X AMPLIFIER input (B2 trigger switched to EXT)	Y channel A or B (B2 trigger switched to INT)
Deflection factor	250 mV/div. in x 1 2.5 V/div. in x 1/10	5 mV/div. to 5 V/div.
Accuracy	± 5 %	± 5 %
Bandwidth to - 3 dB	5 MHz	5 MHz
Input impedance	1 megohm //approx. 35 pF	1 megohm // 22pF ± 2 pF
XY phase error at 50 kHz	3°	3°
Max. permissible input voltage	250 V DC (including peaks of superimposed signals) 500 V AC peak to peak	

Double Lissajous figures can be obtained using both of channels A and B for vertical deflection (CHOPPED mode selected).

1.5.- CATHODE RAY TUBE

- Tube type: TH 8205
- Manufacturer: Thomson CSF
- Pattern: quadripole lens
- Screen:. rectangular, flat face
  . usable area: 8 X 10 cm
  . internal scale (1div. = 1 cm), with adjustable illumination
- Phosphor: standard: P31 (GH)
  optional: P11
- Acceleration voltage (with respect to the cathode): + 1.5 kV
- Post-deflection acceleration voltage (with respect to the cathode): + 15 kV
- Writing speed: 2 cm/ns
- Intensity modulation by external signal
  . bandwidth: DC to 10 MHz, pulsed (minimum duration: 15 ns)

. max. permissible voltage: 30 V

. minimum voltage for blanking: 5 V

. input impedance: $\geq$ 3 kilohms

1.6.- CALIBRATOR

- Output: Square wave, voltage or current
- Amplitude: 600 mV or 20mA, $\pm$ 3 %
- Frequency: 1 kHz approx.
- Output impedance: 30 ohms

1.7.- AUXILIARY OUTPUTS, ⎍ B1 and B2

- Bright-up pulse output, width equal to duration of sweep saw-tooth of B1 and B2
- Amplitude: 5 V approx.
- Output impedance: 500 ohms approx.

1.8.- POWER REQUIREMENTS

- Line voltage: 100 to 140 V
  198 to 264 V
- Line frequency: 48 to 420 Hz
- Power consumption: 110 VA approx.

1.9.- ENVIRONMENTAL

- Temperature:
  . operating: -10° to + 55° C
  . performance guaranteed: + 10° to + 40° C
  . storage: -20° to + 70° C
- Humidity: up to 85 % RH for 10 days at 40° C
- Vibration: $\pm$ 1 mm from 0 to 23 Hz for 15 minutes along each of the 3 axes.

1.10.-DIMENSIONS - WEIGHT

Height: 195 mm
Width: 325 mm
Depth: 490 mm
Mass: 9.5 kg

1.11.- ACCESSORIES

Accessories supplied with the instrument

Operating and sevice manual

Blue screen filter

Two passive probes, 1/10 divider

Protective cover

Accessories available on request

Carrying case for accessories

Elapsed hours counter

Oscillophot camera model M3, M4 or M5 with 1820-29 adapter plate

Rack mounting kit

Consult your Schlumberger sales office for a full list of accessories and auxiliary instruments.

2.- OPERATION

2.1.- PRELIMINARY

2.1.1.- Carrying handle

The handle can be placed in two positions, one for carrying the instrument and the other for use as a tilt stand.

Pull the handle to change its position.

2.1.2.- Switching on

The instrument will operate on any line voltage in the following ranges:

100 to 140 V
198 to 264 V.

The line voltage selector S201 on the rear panel should be placed in the position that matches the local line voltage.

Two fuses for power line protection are incorporated in the selector:

0.63 A for 220 V range
1.6 A for 127 V range.

A warm-up time of 20 minutes is required for thermal equilibrium to be reached.

2.1.3.- Operating conditions

The CRC 5212 oscilloscope is cooled by natural convection. The warmed air is rejected through the perforations on the sides of the case

A space of about 2 cm should be left clear on either side of the instrument.

The CRC 5212 can be operated in ambient temperatures from -10° to + 55° C. The quoted performance is maintained between + 10° and + 40° C. The instrument may be stored between - 20° and + 70° C.

2.2.- DESCRIPTION OF CONTROLS AND INPUT/OUTPUT TERMINALS

2.2.1.- Power - Trace adjustment - Calibrator

S1	ON	Power on/off push-button
DS201		POWER ON indicator lamp
R75	BRILLIANCE	Variable control for adjustment of trace intensity
R108 R66	FOCUS) ASTIG.)	Variable controls for adjustment of trace definition
R21	SCALE ILLUM.	Variable control for adjustment of scale illumination
J202	CALIBRATOR 600 mV - 20 mA →	Source of 1 kHz square wave, amplitude 600 mV with current in the loop of 20 mA
J201		Ground jack

2.2.2.- Vertical deflection - channels A and B

Channel A	Channel B		
S403	S404	VOLTS/DIV.	Deflection factor selector
R422	R438		Vernier for continuous adjustment of deflection factor allowing range over lap. Concentric with selector describ above. The selector is calibrated when the vernier is turned fully clockwise.
DS401	DS402	UNICAL.	Lamp, lights when vernier is not in the CAL. position.
J401	J402	1 MΩ/25 pF	Coaxial input jack for Y signal
S401	S402	DC	Slide selector for input coupling mod direct coupling: the entire signal is transmitted;
		0	input disconnected, and amplifier input grounded;
		AC	DC component of signal blocked.

Channel A	Channel B		
R101	R85	↕	Vertical trace shift control
R15	R34	BAL.	Screwdriver adjustment for eliminating vertical movement of the trace when the sensitivity is changed
R49	R77	GAIN	Screwdriver adjustment for setting the sensitivity of each channel
DS403 DS404		↑ ↓	Lamps indicating in which direction the spot is off screen
S1		x 1 x 5	Push-button for increasing the sensitivity of channel A by a factor of 5
	S2	N. INV.	Push-button for switching the sensitivity of channel B display: N.: normal, positive up INV.: inverted, negative up (used for algebraic sum)
S3		MODE Y	Push-button bank for selecting Y operating mode:
		A	- channel A only
		B	- channel B only
		ALT.	- both channels observed simultaneously by virtue of alternate switching with each sweep
		CHOP.	- both channels observed simultaneously by virtue of switching at a fixed frequency of approx. 500 kHz
		A + B	- display of signal representing the algebraic sum of the inputs to channel A and channel B with normal or inverted polarity
S405		TRIGGER (X in XY)	Push-button bank for selecting the origin of the internal trigger signal, or of the signal applied to the X plates in XY mode
		A	- signal from channel A
		B	- signal from channel B
		A + B	- signals from channel A and channel B, alternated or chopped according to selected Y mode (S3)
		Trigger view	External trigger signal is displayed

2.2.3.- Horizontal deflection

Triggering

B1	B2		
J5002	J6001	TRIGGER (X ampli)	Coaxial input jack for external trigger signal (input to X amplifier at J6001)
S5001		EXT {1/10 / 1	Selector for B1 trigger source: - signal applied to input jack J5001, with or without attenuation of 1/10
		LINE	- line frequency
		INT.	- internal signal, as selected by S40
	S6001		Selector for B2 trigger mode, or of signal applied to the X plates in XY mode:
		Starts after delay	- B2 delayed sweep is initiated at th end of the delayed period
		INT.	- the B2 trigger signal, or the signa applied to the X plates in XY mode, is selected by S405
		EXT. {1/10 / 1	- the B2 trigger signal, or the signa applied to the X plates in XY mode, is that applied to input jack J6001 with or without attenuation by 1/10
S5002	S6002		Selector for mode of coupling trigger signal to trigger amplifier:
		DC ⌐ ¬	- trigger signal coupled directly to amplifier, with triggering of sweep off the positive or negative slope
		AC ⌐ ¬	- AC coupling, blocks the DC componen of trigger signal. Sweep triggered of the positive or negative slope.

B1	B2		
R5002	R6002	LEVEL	Control for setting the level on the trigger signal at which triggering takes place.
		AUTO	- fully clockwise position of R5002, for which B1 sweep free--runs if there is no signal
DS5001		TRIG.	Lamp lights when B1 sweep is triggered

B1 and B2 sweeps

S501 a (B1)	TIME/DIV. B1 - B2	Concentric horizontal sweep rate selectors, calibrated in seconds (s), milliseconds (ms) and microseconds (µs) per division.
	B1 only	- sweep rates (1 - 0.5 - 0.2 s/div. available only for B1
	XY	- first position, selects XY operating mode
R5003 a	HOLD OFF	Control for setting the repetition rate of B1 sweep
	NORM.	- extreme clockwise position for which HF triggering is optimum
R5003 b	VERNIER B1	Vernier for continuous variation of B1 sweep rate
DS5003	UNICAL.	Lamp, lights to indicate when B1 vernier R5003 b is not in the position for which S501 is calibrated
S4		Push-button bank, selects sweep mode:
	B1	- B1 sweep only
	B1 + B2	- B1 sweep is displayed, with the part swept by B2 intensified. The position of this part depends on the setting of delay control R6002
	B2	- the part of the signal swept by B2, which is selected in "B1 + B2" mode, now occupies the whole screen and can be observed in greater detail.

	MIXED	- the first part of the signal visible on the screen is swept by B1, and the following part by B2; the point of transition between the two sweeps is set by the position of R6002
	NORM. SINGLE SWP	- sweep operates normally when this button is released, and in single sweep when it is depressed. In the latter case, only one sweep is initiated by a trigger event.
S6	RESET	Reset button, which prepares the instrument so that a sweep will be initialized when the next trigger event occurs
DS5002		Lamp which lights to indicate that the sweep should be reset
R195	⟷	Dual control, for coarse and fine horizontal trace shift
S5	X 10	Push-button, selects x 10 expansion of the sweep deflection factor: when depressed, the sweep is virtually 100 cm long, and only the 10 cm portion selected by the shift controls is visible on the screen. The sweep rate can extend to 10 ns/div. with this facility.
R6002	1 TURN/DIV. OF B1	10-turn control, sets the delay after which B2 is triggered with respect to B1. This delay can be up to 10 times the sweep rate multiplier selected for B1
		1 turn on R6002 corresponds to the part of the signal swept by B1 that occupies 1 division on the screen.

2.2.4.- Oscilloscope rear panel

J602 J601	B1 B2	Output jacks for bright-up pulses, of width equal to the duration of B1 and B2 sweeps
J301	MOD. EXT.	Coaxial input jack for beam intensity modulation
S201		Line voltage selector, contains the fuses:
	198 - 264 V	- 0.63 A
	100 - 140 V	- 1.6 A

J201		Power input connector
J403	V SIGNAL OUTPUT 50 Ω	Coaxial jack for output of vertical signal: - from channel A or B, according to wether TRIGGER selector S405 is set to A or B - from channel A, followed by channel B, when S3 is at ALT. and S405 at A + B - corresponding to the algebraic sum A + B when S3 is at A + B and S405 is at A + B; S2 can be set to N. or INV. to give A + B or A - B respectively.

2.3.- OPERATING INSTRUCTIONS

The following sequence of operations will enable the user to familiarize himself with the instrument.

2.3.1.- Initial control positions

Oscilloscope switched off.

Cathode ray tube

- Brilliance	fully anti-clockwise
- Focus	mid-travel
- Astigm.	mid-travel
- Scale illum.	fully clockwise

Vertical deflection

- Mode	A
- Trigger	A + B (A and B buttons depressed)
- N - INV	N
- X1 X5	X1
- Volts/div.	0.2 V/div. (channels A and B)
- Shift	mid-travel
- Input coupling	DC

Horizontal deflection

- Function	B1
- Norm. Single swp	Norm.

- Hold off	fully clockwise (norm.)
B1 trigger	Int., ⌐, AC
- B1 level	fully clockwise (AUTO)
- B1 sweep rate	0.2 ms/div.
- B1 vernier	Cal.
- Expansion	X1 (X10 button released)
- 1 turn/div. of B1	1.0
- Shift	mid-travel
B2 trigger	AC, ⌐, Starts after delay
- B2 level	mid-travel

2.3.2.- Switching on

- Check that the local line voltage is in the range selected on the line voltage selector (rear panel)
- Depress the ON button. The indicator lamp will light; the unit will have warmed up sufficiently after a few minutes.

2.3.3.- Trace adjustment

- Turn the BRILLIANCE control until the trace appears.
- Connect the output from the calibrator to the channel A input. Adjust the FOCUS and ASTIG. controls for the finest trace.
- Set the input coupling switch "DC 0 AC" to the 0 position: check that the trace is aligned with a horizontal scale line.

2.3.4.- Balancing

- Leave the input coupling switch S401 of channel A in the 0 position.
- Turn the gain vernier R422 anti-clockwise, UNCAL. lamp DS401 will light. If the trace shifts vertically, readjust BAL. control R15 with a small screwdriver.

Note: this control can also be used for fine balancing of the attenuator between the 5 - 10 - 20 - 50 mV/div. ranges. The user should find the best compromise between attenuator and vernier balance.

- Vernier to CAL. position
- Input coupling: AC
- Volts/division: 0.2 V
- Connect the calibrator to the A and B inputs simultaneously using a second BNC lead and a tee adaptor.
- Center the signal on the screen using the A shift control. The vertical amplitude should be 3 divisions.
- A input coupling to 0: bring the trace to the screen centre.
- Return to the AC position: the displayed signal will be offset downwards from the centre scale line by about 1 division.
- Select B with the Y mode selector, and repeat the operations performed for channel A: the results should be the same.
- Disconnect the calibrator connections.

2.3.5.- "Alternate" operation

- Input couplings: AC
- Y mode selector: ALT.
- Two traces will be seen on the screen.
- Check that the alternate mode operates with all settings of the TIME/DIV. selector.

2.3.6.- "Chopped" operation

- Y mode selector: CHOP
- Time/div. selector: 2 µs
- The traces will be seen to be chopped at the frequency of the electronic switch of the vertical amplifier. The chopping can be triggered by setting the trigger point with the B1 LEVEL control.

2.3.7.- Algebraic sum operation (A + B)

- Input coupling for both channels: DC
- Time/div. selector: 0.5 ms
- Y mode selector: A + B
- B1 LEVEL: Auto.

- Connect the calibrator to both channels: the vertical amplitud will be 6 divisions.
- Depress the N - INV. button of channel B: a straight line will now be displayed, since the algebraic sum of the two signals is zero (provided that the sensitivities of the both channels are the same).
- Release the button to the N position.

2.3.8.- B1 triggering

- Y mode selector to A
- Trigger source selector to A + B
- Volt/div. selectors to 0.2 V.

a) AUTO mode:

- Turn the B1 LEVEL control fully clockwise.
- The signal is triggered, and the TRIG. lamp DS5001 lights.

b) NORMAL mode (LEVEL control turned towards the left):

- The signal is triggered when the LEVEL control is correctly set, and TRIG. lamp DS5001 lights.
- Return to the AUTO position.

c) Trigger slope

- Move selector S6002 to ⌞ : the trace starts on the falling edge of the signal.
- Return to the ⌜ position: the trace starts on the rising edge of the signal.

d) B1 TRIG selector to DC

- MODE Y selector to A
- TRIGGER selector to A. The signal is correctly triggered. If the input is disconnected from channel A, the triggering cease Select A + B again with the TRIGGER selector, and the triggering returns. The same applies to the B position.

e) Connect the calibrator to the channel A input and to the B1 TRIGGER input jack; set the B1 trigger source selector to EXT 1. Ymode: A.
Correct triggering is obtained.

- Select EXT 1/10: in NORMAL mode the rang of the LEVEL control over which triggering is obtained is much smaller. Return to INT.

2.3.9.- B2 triggering

X mode: B2 B2 TRIGGER: INT. B2 TIME/DIV.: 0.2 ms
Perform the same operations as for B1 triggering, but only in normal mode (STARTS AFTER TRIGGER). Then disconnect the calibrator from B2 TRIGGER input.

2.3.10.- Expansion

- Select TIME/DIV. of 2 ms
- X Mode selector: B1
- Depress the X10 button: the same deflection factor will be obtained as for 0.2 ms/div. with the button released. The expansion of the sweep is symmetrical about the scale centre.
- Return to 1 ms and X1.

2.3.11.- B2 delayed sweep

a) X mode selector to B1 + B2:
- B2 TRIGGER mode: Starts after delay, AC, ⌐.
- B2 TIME/DIV. selector to 0.1 ms
- Part of the trace will be seen to be intensified; it takes up about 1 division, and moves along the whole trace when the "1 TURN/DIV. OF B1" control is turned. Reduce the trace brilliance.
- With B2 sweep triggered (B2 TRIGGER mode to INT.), as the 1 TURN/DIV. OF B1 control is turned the intensified portion will jump from one positive slope to the next. The same applies to the negative slopes if selector S6002 is set to the corresponding position.
- Turn the LEVEL control of B2 TRIGGER: the intensified portion will disappear when the control is at either end of its travel
- Bring the intensified portion back.

b) X mode selector to B2

- The delayed signal appears on the screen, and remains fixed if the 1 TURN/DIV. OF B1 control is turned.
- Select STARTS AFTER DELAY: turn the 1 TURN/DIV. OF B1 control, and the signal will move across the screen.

2.3.12.- Mixed sweep

- X mode selector to MIXED.
- The first part of the trace sweeps at the selected B1 rate, and the following part at the B2 rate. The starting point of the B2 sweep moves along the whole length of the trace as the 1 TURN/DIV. OF B1 control is turned.

2.3.13.- Single sweep

- Mode: B1
- B1 trigger: NORM
- Depress the NORM. - SINGLE SWP button: the trace will disappea
- Press the RESET button: a single sweep of the signal will be seen on the screen.
- Disconnect the signal from the channel A input, and press RESET again: the RESET lamp will go out, showing that the instrument is ready.
- Connect the signal to the channel A input again: a single swee of the signal will be seen on the screen, and the RESET lamp will then light.
- It is advisable to offset the trigger level by about 1 cm to minimize the risk of triggering on interference.

2.3.14.- XY mode

a) X deflection provided from the X AMP. input

- TIME/DIV. selectors to XY
- B2 TRIG. selector to EXT. 1
- Connect the calibrator to the A input and to the X AMP. input, and center the resulting trace on the screen: its vertical amplitude is about 3 divisions, and its horizontal amplitude about 2.5 divisions. Adjust the brilliance.
- Select EXT 1/10: the horizontal amplitude is divided by 10. Return to EXT.1.

b) X deflection provided by one of the Y channels

- Adjust the vertical position of the two traces to the screen centre.
- Connect the A and B inputs in parallel to the calibrator, and select the following control positions:
- Y mode selector to A
- X in XY selector to B
- A and B deflection factors: 0.2 V/div.
- B2 TRIGGER mode: INT (XY)
- B2 input coupling: DC (XY)

Channel A now drives the vertical deflection (3 div.), and channel B the horizontal deflection (3 div.).

With the Y mode selector set to B and the X in XY selector set to A, channel A then drives the horizontal deflection and B the vertical deflection.

If the displayed image needs to be centered in the horizontal direction, use the X shift controls R295 a and b rather than the vertical shift of the channel used in X, so as to conserve the full dynami range of the amplifiers.

c) Double Lissajous figures

- Y mode selector to CHOP.
- B2 TRIGGER mode to EXT.

Channels A and B are now used for the two vertical deflections, and the signal from an external generator applied to the X AMP. input provides the common horizontal deflection.

2.3.15.- External modulation

- X MODE selector: B1, NORM.
- Y MODE selector: A
- TRIGGER selector: A
- Channel A VOLTS/DIV.: 1 V
- B1 TIME/DIV.: 1 ms
- Reduce the trace brilliance.
- Apply a 1 kHz sine wave, amplitude 5 V peak to peak minimum, to the EXT. MOD. jack (rear panel) and to the A input. The trace modulation will give blanking of the positive parts of the trace, and intensification of the negative parts.

2.4. - TRIGGER MODE SELECTION

Y mode (S3)	Trigger mode (S405)	NORM-INV Channel B (S2)	Trigger signal source
A	A		Channel A signal
	B	Norm. Inv.	Channel B signal Channel B signal, inverted
	A + B	Norm. Inv.	Sum of signals : A + B Difference of signals : A - B
	A		Channel A signal
	B	Norm. Inv.	Channel B signal Channel B signal, inverted
	A + B	Norm. Inv.	Sum of signals : A + B Difference of signals : A - B
ALT.*	A		Channel A signal
	B	Norm. Inv.	Channel B signal Channel B signal, inverted
	A + B*	Norm.	Channel A signal and channel B signal, alternating with each sweep
	Inv.		Channel A signal, and channel B signal inverted, alternating with each sweep
CHOP.	A		Channel A signal
	B	Norm. Inv.	Channel B signal Channel B signal, inverted
	A + B	Norm. Inv.	Sum of signals : A + B Difference of signals : A - B
A + B	A		Channel A signal
	B	Norm. Inv.	Channel B signal Channel B signal, inverted
	A + B	Norm. Inv.	Sum of signals : A + B Difference of signals : A - B

* "ALT." Y mode and "A + B" trigger mode (marked *) : When these two modes are selected simultaneously, the triggering is affected by the actual form of the Y channel signals. If the Y signal amplitude is small, the 2 traces should not be shifted too far apa

NOTE :

Y mode : "A", with "x5" expansion and "AUTO" sweep : the sweep can sometimes stop very briefly. This is caused by noise spikes picked up by the high sensitivity of the Y channels and of the trigger circuit.

3. - CIRCUIT DESCRIPTION

3.1. - GENERAL PRINCIPLES

The block diagram (fig. 1) shows the main circuits of the CRC 5212 oscilloscope, and gives an overall view of the operation of the instrument. Detailed operation will be examined with each circuit.

3.1.1. - Vertical deflection (Y subassembly - PCB Z3)

The signals to be displayed on the screen are applied to both or one of the "Channel A" and "Channel B" inputs. They are then attenuated or amplified according to the selected deflection factor (in volts/division). Each channel has an input switch and potentiometers for trace shift, gain adjustment and balancing.

A trigger signal picked off the Channel A or Channel B preamplifier is amplified by the trigger preamplifier.

The input signal applied to channel A or channel B is made available at the "V signal" output.

The preamplifier for each of channel A and channel B is a linear integrated circuit, which also includes the trigger pick-off circuitry, and hold-off circuitry for channel switching to give the following operation modes :

A, B, Alt., Chop., B $\pm$ A

The signals are then routed via a delay line to the vertical amplifier, and then to the vertical deflection plates of the cathode ray tube.

3.1.2. - Horizontal deflection (X subassembly - PCB Z2)

There are two time bases, B1 and B2, for horizontal deflection ; they may be combined in the following modes : B1 only , B1 delaying B2, with B2 intensifying B1 B2 delayed only ; B1 and B2 mixed, with B1 providing the first part of the sweep and B2 the second part. In XY mode, the X amplifier drives the horizontal deflection.

The time bases are triggered by the B1 and B2 trigger circuits respectively.

The X sweep signals are amplified to the level required for driving the horizontal deflection plates of the cathode ray tube by the horizontal amplifier.

X1, X10 expansion is obtained in this amplifier by gain variation.

3.1.3. - Z modulation - Calibrator - General power supply : PCB Z1

Z Modulation

Pulses from the B1 and B2 time bases modulate the cathode ray tube brightness via the bright-up amplifier. The tube is supplied by the EHT converter.

The "External Modulation" input is DC coupled to the cathode ray tube via the bright-up amplifier.

Calibrator - General power supply

The calibrator is an auxiliary circuit which supplies calibrated amplitude rectangular signals and current pulses used for checking and setting up the channel A and channel B amplifiers and probes.

The general power supply provides all the voltages used by the various circuits of the oscilloscope.

3.2. - Y SUBASSEMBLY - PRINTED CIRCUIT BOARD Z3 (Fig. 4 and 4 bis)

3.2.1. - Channel A input (Fig. 4)

The channel A input circuit comprises input coupling selector S401, 10-position attenuator S403 a and b, an impedance converter stage, and low impedance attenuator S403 c.

The input coupling selector has 3 positions : DC, 0, AC :

- the "DC" position couples the signal directly to the attenuator
- the "0" position grounds the attenuator input, for locating the zero reference level of the amplifier
- the "AC" position blocks the DC component of a signal.

Attenuator

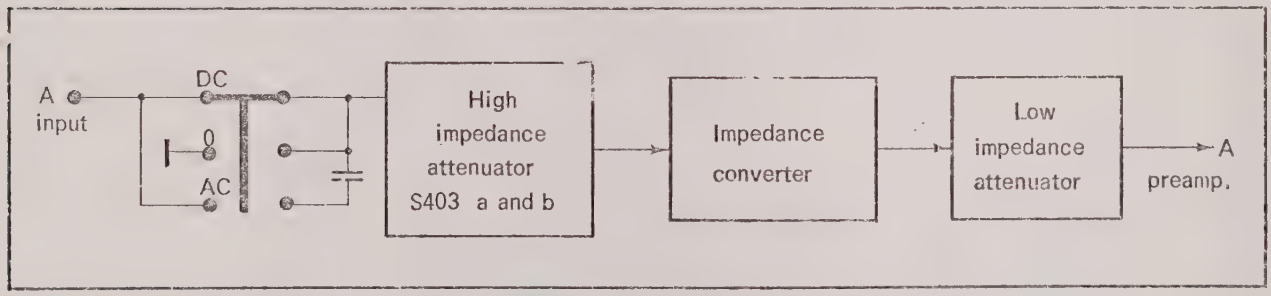
Attenuator S403 (volts/div. and mV/div.) is of traditional design. It consists of resistance-capacitance cells with frequency compensation. All the attenuator positions offer a constant input impedance of 1 MΩ/22 pF.

The basic sensitivity of the amplifier is 5 mV/div., and the 10 mV, 20 mV and 50 mV deflection factors are obtained by means of the low impedance attenuator (S403 c). All the other deflection factors are obtained by dividers S403 a and b combined with the low impedance attenuator positions.

Impedance converter

The impedance converter consists of two field effect transistors Q1 and Q6 driving emitter followers Q3 and Q5. The stage has a high input impedance and low output impedance.

The field effect transistors are supplied by current generators Q2 and Q4.



Channel A input

Transistor Q1 is protected against overloads at the input by network C2 - R3 - CR1. Potentiometer R15 balances the amplifier.

Gain vernier R422 is wired between the emitters of Q3 and Q5 and provides overlapping of the deflection factors. The signal picked off its terminals is routed to the inputs of the channel A preamplifier.

3.2.2. - Channel B input (Fig. 4)

The input circuits of channel B are identical to those of channel A input.

The input coupling selector is S402.

The high impedance attenuator is switched by S404 a and b; the low impedance attenuator is switched by S404 c.

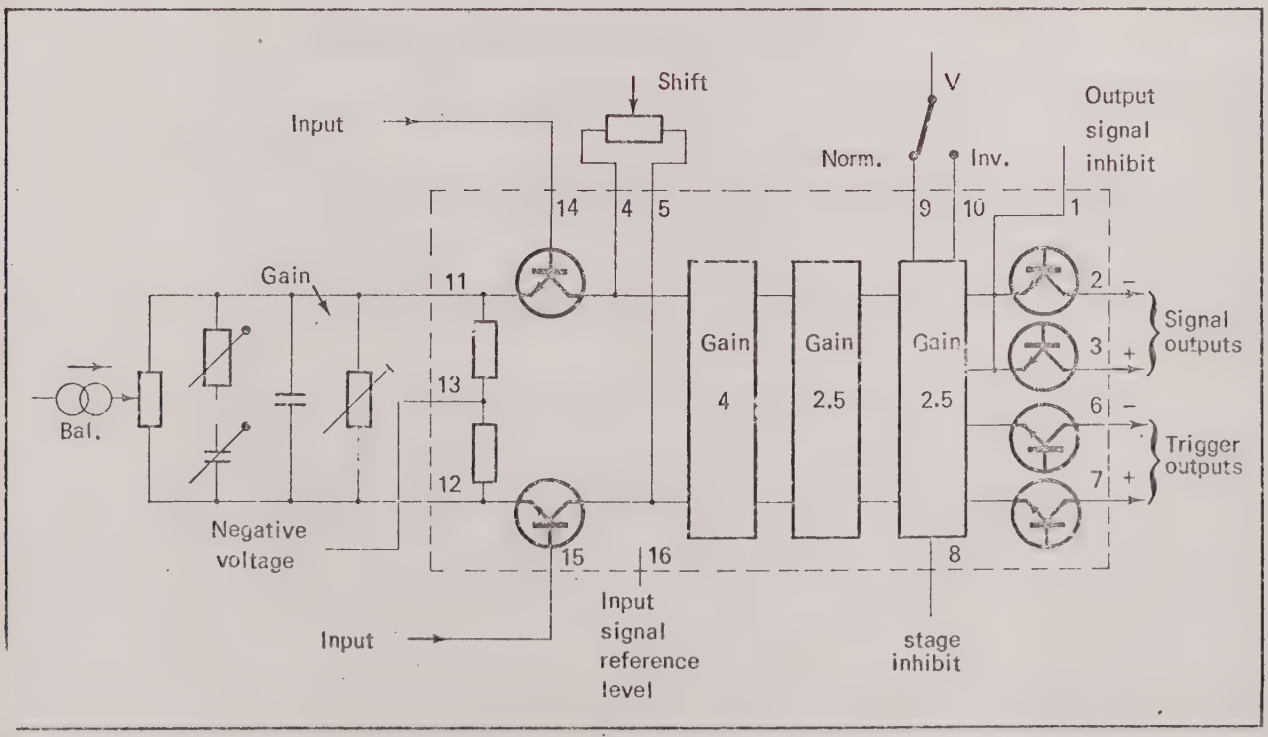
The impedance converter consists of transistors Q7 to Q12.

The gain vernier potentiometer is R432.

The balance potentiometer is R34.

3.2.3. - Channel A preamplifier (Fig. 4)

This preamplifier consists of linear integrated circuit U1 (A250). A block diagram of this circuit is shown below, and the description is on page 55, paragraph 3.5



Block diagram, integrated circuit A250

Potentiometer R49 is accessible from the front panel. It defines the gain of this preamplifier, and is used for adjustment of channel A gain.

The gain is multiplied by 5 when switch S1 is closed (push-button depressed).

The integrated circuit is supplied by current generator Q13.

Potentiometer R45 balances the stage in "X1" gain, and RC networks R50 - C20, R52 - C22, and R51 - C21, with C19, provide frequency compensation.

Channel A shift is controlled by potentiometer R101 which is connected between pins 4 and 5 of U1 .

With X5 gain, potentiometer R203 balances the stage.

The channel A switching command is applied to pin 1 of integrated circuit U1.

The trigger output is available in differential mode on pins 6 and 7 of U1. The amplified Y signal is available on outputs 2 and 3.

3.2.4. - Channel B preamplifier (Fig. 4)

This is of the same design as channel A, and consists of integrated circuit U9 (A250). It also has :

- the circuit which provides the + 10 V supply voltage for U1 and U9 : transistor Q17, biased by divider R82-R83, with diode CR8 for temperature compensation ;
- switch S2 which connects the + 10 V either to pin 9 (norm.) or to pin 10 (inv.).

The various adjustments are :

R74 : channel B balancing
R77 : channel B gain
R85 : shift

3.2.5.- Channel switching control (Z4 - Fig. 4)

The channel switching commands are routed at low impedance to pin 1 of integrated circuits U1 and U9, by transistors Q1 and Q2 on PCB. Z4 : the preamplifier is inhibited by the higher potential of the command signal and enabled by the lower potentiel.

3.2.6.- Trigger signal viewing (Z3 - Fig. 4)

When the "trigger view" push-button S405 b is depressed :

- preamplifiers A and B are disconnected, by application of a positive potential to :
  - . the anodes of diodes CR1 and CR2 on Z4 which inhibit U1 and U9 via their pin 1 inputs
  - . the channel switching circuit (fig. 4 bis) which is then held off
- the trigger signals are routed to the delay line input as follows : trigger signal amplifier Q14 - U12 a, Q15 - U12 d, which is supplied by current generator U12 e, is enabled when transistors U12 b and c are turned off.

3.2.7.- Output circuit of preamplifiers A and B

The outputs of preamplifiers A and B and of the "trigger view" circuit are applied in parallel to the input of delay line DL1 (150 ns). R109 and R110 terminate the line input, and R113 and R114 terminate its output. Bridged-T inductor L2 compensates for phase distortion introduced by the delay line.

Networks C36 - R111 and C37 - R112 provide frequency compensation of the line. The delay line and its termination resistors act as the output load of the preamplifiers and of the "trigger view" circuit.

Reduction of the mean output level in A + B mode

In the "A", "B", "A and B" (alternate or chopped) modes in which the 2 channels are never operating simultaneously, and also in "trigger view", the supply current for the A and B preamplifiers is derived from the + 14 V by divider R115 - R116. This current sets the mean output level of the preamplifiers or of the "trigger view" circuit.

In order to maintain the same mean value in "A ± B" mode in which both preamplifiers are operating, resistor R116 is short-circuited by transistor Q21 which is turned fully on by Q22. Q22 is also driven into saturation by the voltage applied to its base in "A + B" mode by the channel switching logic (fig. 4 bis).

3.2.8. - Vertical amplifier (fig. 4 bis)

The vertical amplifier comprises mainly integrated amplifier A 250 (U11) : see integrated circuit block diagram on page 27.

The Y + and Y - signals from the delay line are applied to inputs 14 and 15 of U11.

Potentiometer R144 balances the amplifier. Its gain is determined by R130 and R131. Frequency compensation is provided by cells :

R127 - C44
R126 - C43
R126 - C42
R124 - C41
and C45

The output signals from U11 are routed to the Y plates of the tube via a symmetrical stage consisting of Q25 and Q26 which are in common base configuration.

Emitter-follower transistors Q24 and Q25 provide the bias voltages for U11 and the bases of Q25 and Q26.

3.2.9. - Channel switching logic (Fig. 4 bis)

The following logic levels are found in the various TTL circuits of this instrument :

	input	output
high level (1 state)	- 3.8 V	- 2.4 V
low level (0 state)	- 4.4 V	- 4.8 V

The different gates contained in the same integrated circuit package are identified by the output pin number, for example : U4-8.

Bistable U3 can take up two states :

state A : Q output : 1 $\overline{Q}$ output : 0

state B : Q output : 0 $\overline{Q}$ output : 1

The Q and $\overline{Q}$ outputs are inverted by gates U4-4 and U4-8, and then drive the switching circuit. In state A, channel A is switched to the output while channel B is inhibited. In state B the opposite occurs.

This bistable is commanded in different ways according to the operating mode.

A Mode

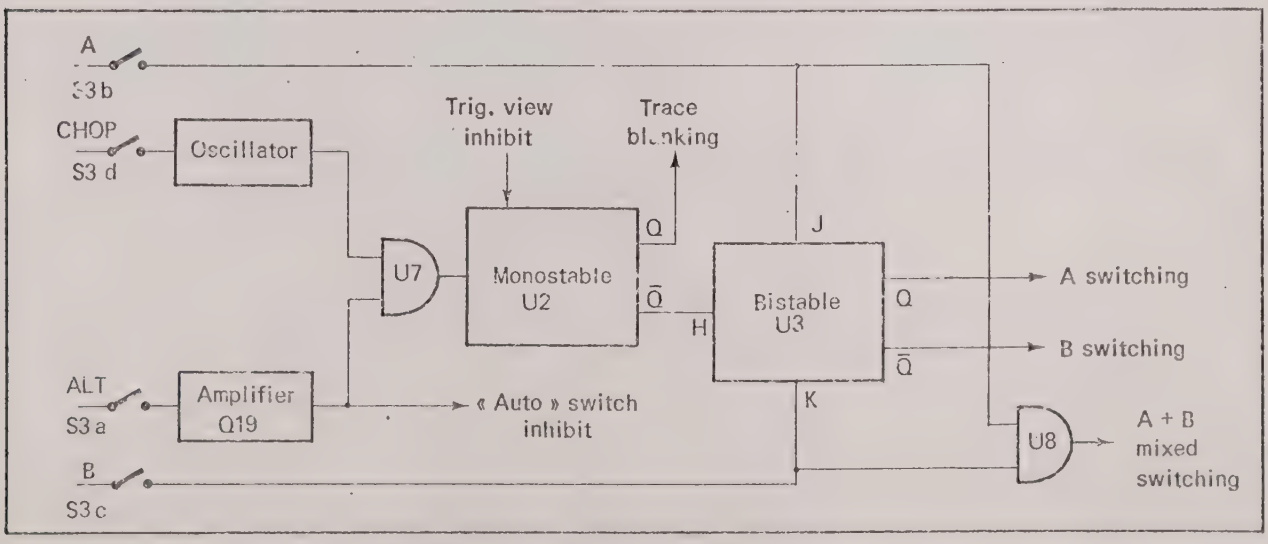
Logic 1 at the S input holds the bistable in the A state, and channel A is in use.

B Mode

Logic 1 at the R input holds the bistable in the B state, and channel B is in use.

A + B Mode

The inputs of inverters U8 - 11 and U8 - 8 are held at logic 0. Thus the inputs of gate U8-3 are at logic 1 and its logic 0 output commands via U8-6 the reduction in the mean output level of the A and B preamplifiers in parallel (Q22 - Z3 - fig. 4).



Block diagram of channel switching logic.

Chopped mode

A 1 MHz oscillator, U7 with R104 and C46 to set the frequency, is switched on. The output pulses from this are routed via OR gate U7-8 to monostable U2 for shaping. The $\overline{Q}$ output of U2 drives the clock input of bistable U3, which divides the frequency by 2.

The R and S inputs of U3 are at logic zero, so the bistable switches between the A and B states at 500 kHz.

The Q output of U2 commands trace blanking during the switching.

Trigger view

A positive level is applied to inputs 3 and 4 of U2 in "trigger view" mode to hold off U2, and inhibit the channel switching.

Alternate mode

A pulse supplied at the end of B1 sweep (via gate U2-15 on circuit board Z2) is shaped and amplified by Q19 and then gated by U6-6 (opened in ALT. mode by S3 a) and U7-8 to monostable U2 which commands the changes of state of bistable U3.

A signal is picked off Q19 collector to inhibit the "automatic" switch (B1 time base - PCB Z2) to prevent it changing state on spikes that occur during channel switching.

3.2.10. - Trigger amplifier (Fig. 4 bis)

The trigger signals from the A and B preamplifiers are always available on the bases of Q29 and Q30 for channel A trigger, and on the bases of Q32 and Q31 for channel B trigger, since the pick-off circuit for these signals is not inhibited during channel switching.

The outputs of amplifier stages Q29 - Q30 and Q31 - Q32 are in parallel ; they generate a current which drives output stage Q33 - Q34.

The overall gain is defined by :

- R158, R159 with adjustment by R160 for channel A
- R171, R170 with adjustment by R169 for channel B.

The load resistors of the 2 amplifiers are R178 and R189.

Frequency correction is obtained by capacitors C52 (channel A) and C56 (channel B).

The quiescent DC level of the amplifier output, on Q34 collector (test point TP1), is set up with R155 (channel A) and R173 (channel B).

Integrated amplifier U10 stabilizes the DC output level. This amplifier compares the level picked off the collectors of Q33 and Q34 via R179 and R189 with the 0 reference level, and modifies the supply current of Q33 and Q34 accordingly.

In CHOPPED mode, push-button S2 drives transistor Q36 into saturation via diode CR18 ; Q36 thus grounds capacitor C60. R188 and C60 thus filter the trigger signals. In the other operating modes, Q36 is turned off and the filter is disconnected.

3.2.11.- Trigger control logic (Fig. 4 bis)

The trigger control logic consists of integrated circuit U5 and U6. It controls the supply of power to one or the other of the trigger amplifier stages (channel A or channel B) or to the two stages simultaneously, thus selecting triggering from one or other of the channels, or from channels A ± B mixed.

The control logic is commanded by push-buttons S405 a (A trigger), S405 b (B trigger), and S3 a (ALT. mode). The contacts of each of these switches are open when the switch is depressed, so that they apply logic 1 levels to the U5 and U6 gates. When any of these switches is released its contacts are closed and so the corresponding gate inputs have a logic 0 applied.

A) Y modes : A, B, A + B or CHOP.

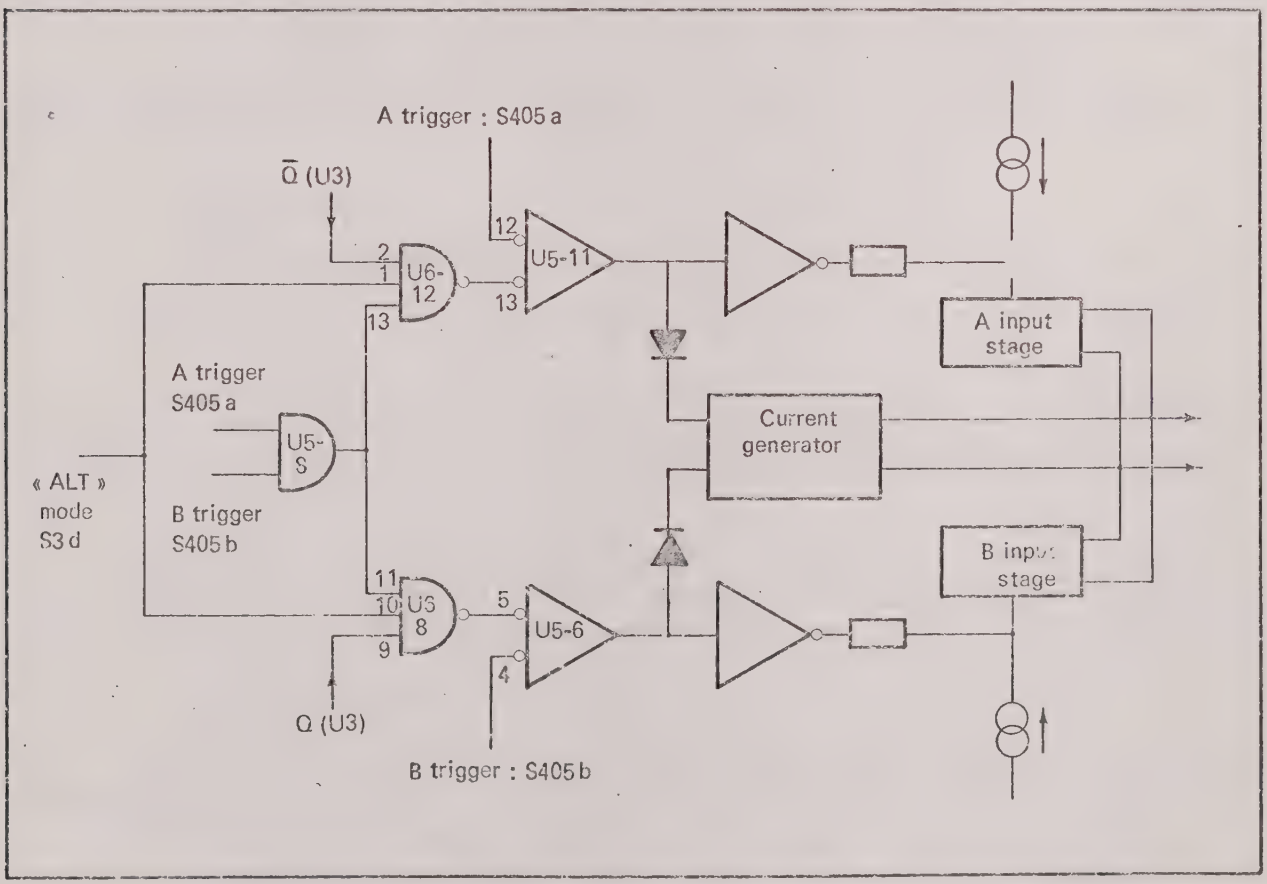
When S3 a is closed, NAND gates U6-12 and U6-8 receive a logic 0, and their outputs are thus held at logic 1 which has no effect on OR gates U5-11 and U5-6. The latter can thus be commanded respectively by their inputs 12 and 4.

- A triggering : S405 a open
S405 b closed

The 2 inputs of U5-11 are at logic 1, so its output is at logic 0. U4-12 therefore sinks no current, and the current from R153 supplies the A trigger stage.

Input 4 of U5-6 is at logic 0, its output is at logic 1 and the current from R176 is by passed through R175 : the B trigger stage is not supplied.

The output of U5-6 is at logic 1, and switches on, via diode CR17, an additional current generator Q27 - Q28, which drives the outputs of the A and B stages of the trigger amplifier in parallel.



Block diagram of trigger switching logic.

- B triggering : S405 a closed
S405 b open

The opposite states from the above are obtained at the outputs of gates U5-11 and U5-6 : the A input stage is not supplied, since the current is by passed through R154 ; the B input stage is supplied, since U4-10 no longer sinks the current from R176.

The additionàl current generator Q27 - Q28 is also switched on via diode CR1

- A + B triggering : S405 a and S405 b open

The outputs of gates U5-11 and U5-6 are simultaneously at logic 0, both input stages of the trigger amplifier are supplied and operate in parallel, thus giving the algebraic sum of the A and B trigger signals.

Current generator Q27 is switched off : the mean output level is thus held constant.

B) ALT. mode

- A or B triggering

One of the contacts S405 a or S405 b is open, while the other is closed.

Only one of the inputs to U5-8 is at logic 1, the output is thus at logic 1 and inputs 13 of U6-12 and 11 of U6-8 are at logic O. These two gates are therefore closed and changes in state of the Q and $\overline{Q}$ outputs of U3 are not transmitted : their outputs remain at logic 1.

Operation is therefore identical to that described above for the other Y modes : depending on whether A trigger or B trigger is selected, one or other of the amplifier stages is supplied and the additional current generator is switched on.

- A + B triggering

The 2 contacts of S405 are open, both inputs to gate U5-8 are at logic 1, its output is thus at logic 0.

S3 d is open (ALT. mode)

Inputs 1 and 13 of U6-12 and 10 and 11 of U6-8 are thus at logic 1. The output level of these gates thus depends on the state of the Q and $\overline{Q}$ outputs of bistable U3, namely on which Y channel is switched to the output.

When Q is at logic 1, and $\overline{Q}$ at logic 0, channel A is switched :

- input 2 of U6-12 is at logic 0, its output remains at logic 1. U5-11 receives 2 logic 1 levels, thus its output is at logic 0 and switches on the supply to the A trigger stage.
- input 9 of U6-8 is at logic 1. The 3 inputs of this gate are at logic 1, its output is at logic 0, thus U5-6 output is at logic 1. B trigger stage is not supplied.

The opposite situation occurs on the next alternation, when Q goes low and $\overline{Q}$ goes high (channel B switched) : the 3 inputs of U6-12 are then at logic 1 and switch off the A trigger while B trigger is switched on.

The additional current generator remains on.

Thus, triggering occurs alternately on the A signal when channel A is switched, and on the B signal when channel B is switched.

NOTE :

- When channel B is inverted, the B trigger signal is inverted at the output of preamplifier U9 (fig. 4). In A + B trigger, when channel B is "normal", the trigger signal equals the sum of the A and B signals ; when channel B is "inverted" the trigger signal equals the difference of the A and B signals.
- In the "A + B" Y mode, triggering can occur on the A signal, the B signal or on the algebraic sum of the signals according to selection.
- The various internal trigger sources that can be selected are summarised in the table on page 24.

3.3. - X SUBASSEMBLY - PRINTED CIRCUIT BOARD Z2 (Figs. 5-6-7)

3.3.1. - Input switches (Fig. 5)

The signals for triggering B1 time base arrive on selector switch S5001, the trigger source selector :

- Internal : the source is the trigger amplifier
- Line : the source is the general power supply
- External - External 1/10 : the source is external to the oscilloscope and is connected to input J5001. In the "1/10" position a divide-by-ten attenuator is inserted.

Switch S5002 selects the edge of the signal on which triggering occurs (⎍ or ⎎) and the coupling mode : in the DC positions the signal is routed directly to the input ; in the AC positions capacitor C3 is put in series to eliminate the DC component of the signal.

3.3.2. - B1 trigger circuit (Fig. 5)

Field effect transistor Q1 with follower Q2 comprises the high-impedance input. Components C5-R5-CR1-CR2 protect Q1 against input overloads.

The signal is picked off Q1 and routed by transistor Q17, which is in follower configuration, to the trigger view circuit (fig. 4).

Differential clipping amplifier Q3 - Q4, supplied by current generator Q7, receives the trigger signal on Q3 base. The voltage applied to the base of Q4 dépends on the trigger mode :

- in TRIGGERED mode it receives via Q6 the voltage set by the LEVEL potentiometer which fixes the clipping level ;
- in AUTO mode it receives the mean voltage of the signal picked off Q2 emitter by circuit R18 - C13.

The switch coupled with LEVEL potentiometer R5002 selects TRIG. or AUTO mode. This switch drives Q6 intc saturation in TRIG. mode and Q5 into saturation in AUTO mode.

The potentiometer is not used in AUTO mode (fully clockwise position of the potentiometer) ; the fixed level is defined by the mean voltage of the input signal.

The travel of the LEVEL potentiometer is centered by R34. In AUTO the level is centered by R25. The mean voltage of Q3 and Q4 collectors is adjusted by R23.

Trigger edge sélection is carried out by connecting the collector of Q3 or of Q4 to U1 input.

ECL gates U1-14 and U1-15 are configured as Schmitt triggers ; their hysteresis determined by R35, R36, R38, R39. They are wired in cascade and shape the trigger signal which is routed both to the time base and to accumulator circuit Q9 - Q10 via amplifier Q8.

"AUTOMATIC" circuit

Accumulator circuit Q9 - Q10 is used for the automatic operation of B1 time base

When there is no trigger signal, the time base free runs and sweeps continuously, thus giving a bright base line on the CRT screen.

When the trigger signal makes Schmitt U1-15 turn over, a negative pulse is obtained from Q8 : Q9 conducts as does Q10 which is linked by positive feedback to Q9 base. Successive pulses discharge capacitor C20 which supplies a DC voltage that keeps Q11 saturated. Q11, via U2-2, inhibits the free running of the sweep which is then triggered by the trigger pulse applied to the clock input of bistable U3 A.

Lamp DS5001, which indicates that the sweep is triggered, is switched on both in AUTO and TRIG. modes by Q11 when it goes into saturation.

3.3.3. - B1 time base (Fig. 5)

3.3.3.1. - General

The time base is designed to produce three voltages simultaneously :

1) A sawtooth voltage for the horizontal deflection. When S3 is in the "B1 + B2" position, this voltage drives the delay circuit (Fig. 6).

2) A negative rectangular signal for the bright-up amplifier ; the width of each pulse equals the width of the linear part of the rising edge of the sawtooth.

3) A positive pulse is produced at the end of each linear fall segment of the sawtooth, and is used for driving the "ALT." function. This pulse appears on pin 9 of the connector of PCB Z2.

B1 time base can be divided into several subassemblies :

- the sweep command bistable (integrated circuit U3 A)
- the Miller integrator (transistors Q25 and Q24)
- the sweep fly-back circuit
- the single sweep circuit (integrated circuit U3 B).

3.3.3.2. - Miller integrator

This consists of transistors Q24 and Q25 and the R and C components switched by the sweep rate selector S501 a. The voltage applied to the resistor R, fixed by transistor Q27, can be adjusted with vernier R5003 b. The switch coupled to this vernier potentiometer is closed throughout the vernier travel and lights the UNCAL. lamp DS5003.

1) During the sweep :

- Q20 is saturated
- diode switch CR13 - CR14 is open.

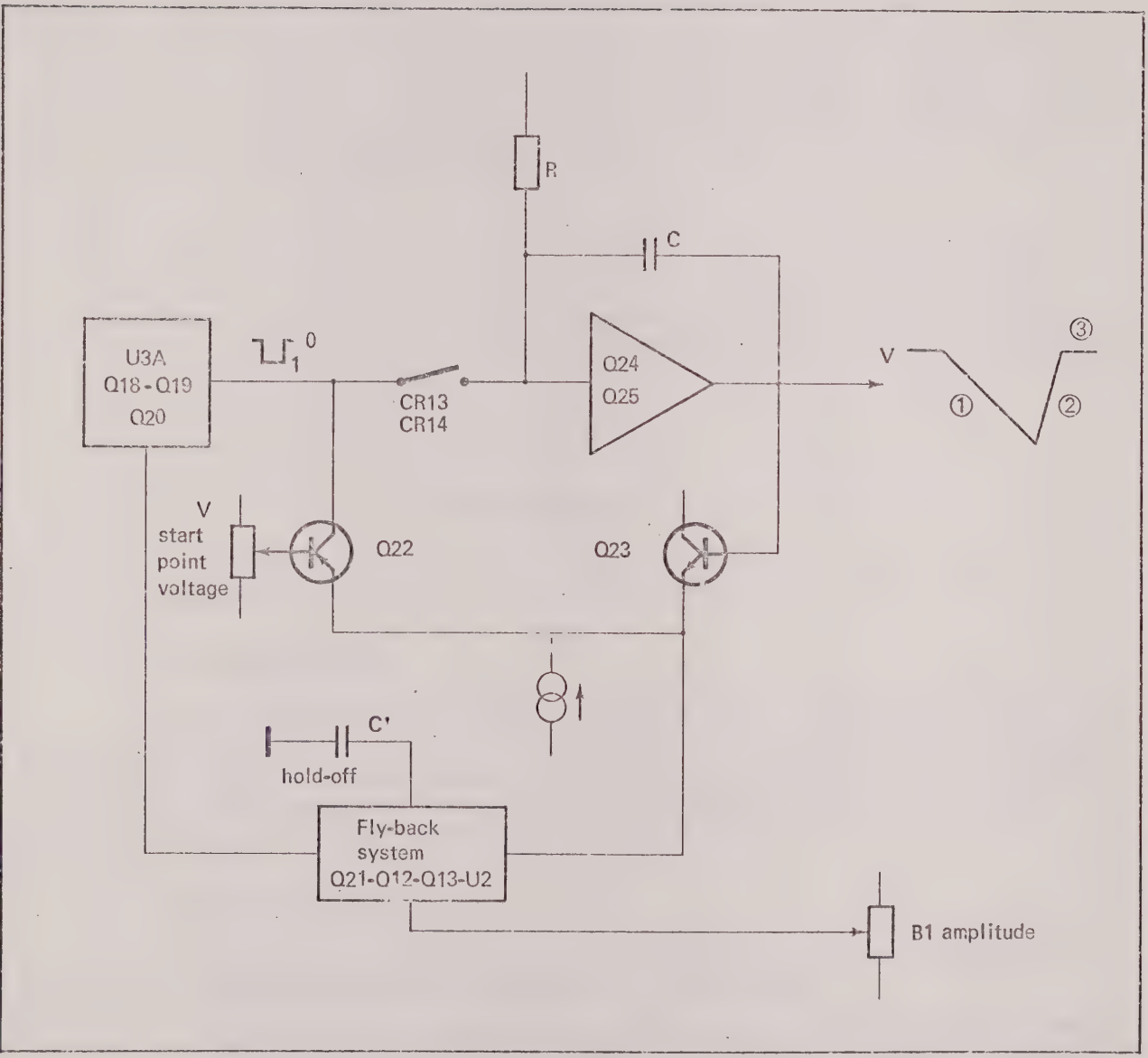
The Miller amplifier thus charges capacitor C with a constant current via resistor R. This gives the ramp of the sweep sawtooth. Time constant RC defines the sweep duration.

2) At the end of the sweep :

- Q20 is turned off
- diode switch CR13 - CR14 is closed.

Capacitor C discharges, and the sawtooth returns to the start point voltage.

When the sawtooth reaches the start point voltage V which is fixed by potentiometer R71, transistors Q22 and Q23 conduct. These transistors form a loop round the Miller amplifier so that its output is locked to the start point voltage V.



3.3.3.3. - Sweep command

Transistor Q20 is driven by bistable U3 A via Q18 ; the latter is in common base configuration to shift the DC level between these two components.

Bistable U3 A is driven by the fly-back system.

3.3.3.4. - Hold-off

The object of the hold-off circuit is to delay the triggering of a new sweep. To this end, the sawtooth picked off Q23 emitter is routed to Q21 :

- during the negative ramp of the sweep sawtooth, hold-off capacitor C' (selected by S501) is discharged into a low impedance via Q21 ;
- during the fly-back of the sawtooth to the start point voltage, the emitter potential of Q21 rises at a rate defined by C', R63 and R5003 a. Since the base potential of Q21 rises faster than the emitter potential, this transistor is turned off. The hold-off circuit sawtooth is picked off by impedance converter transistor Q12.
  Potentiometer R5003 a, on the front panel, sets the value of the hold-off delay.

3.3.3.5. - Fly-back system

The switching of bistable U3 A is commanded by the detection of two thresholds.

Upper threshold

The upper threshold is defined by R58 and R59, and detected by Schmitt trigger U2-3 ; it corresponds to the start point voltage of the sawtooth. This Schmitt trigger supplies a pulse train whose negative edges reset bistable U3 A to logic 1 via gate U2-2. The $\overline{Q}$ output of this bistable switches to logic 0, which drives Q20 into saturation via Q18 and thus triggers the start of the sweep.

Lower threshold

The lower threshold is defined by R60 - R61. When the sawtooth ramp reaches this threshold, Schmitt trigger U2-14 switches and :

- resets bistable U3 A to zero : its $\overline{Q}$ output thus goes to logic 1 and turns off Q20 via Q18 which makes the sawtooth fly back to the start point voltage
- switches Y channels in ALT. mode by means of the signal output from U2-15 via pin 9 of the Z2 connector to PCB Z3 (fig. 4 bis).

The - 1.3 V bias voltage for the Schmitt triggers is derived from the - 5.2 V line by transistors Q15 and Q16.

a) Free running sweep (level potentiometer R5002 in AUTO position, without trigger signal) : when the start point voltage is reached, the upper threshold circuit initiates a new sawtooth ramp ; the end of the ramp and fly-back to the start point voltage are initiated by the lower threshold circuit. The sweep thus continues to free run.

b) Triggered sweep

The set input of bistable U3 A is disabled to prevent the sweep free-running. This done by gate U2-2, whose input 5 is held at logic 0 defined by resistive devider R28-R51 which is connected to the - 5.2 V line via CR5 and the switch coupled to LEVEL potentiometer R5002.

In this case a new sweep is initiated by the trigger signal which is applied to the clock input of bistable U3 A (pin 6 of U3), which makes the $\overline{Q}$ output switch to logic 0.

c) Automatic sweep with trigger signal at input

As in triggered mode :

- the free-running of the sweep is inhibited by disabling the set input of bistable U3 A by means of gate U2-2. But in this case, the logic 0 applied to input 5 of this gate is obtained from the accumulator circuit Q9 - Q10 - Q11 which receives the trigger signals ;
- the sweep is initiated by trigger pulses applied to the clock input of bistable U3 A.

The upper threshold circuit (U2-3) supplies a positive pulse whose duration is equal to the duration of the sweep ramp plus the hold-off. This pulse is applied to the CC input of U3 A and prevents the bistable from switching again during this period.

3.3.3.6. - Single sweep

The control circuit in "single sweep" mode (push-button S4 d depressed) consists of bistable U3 B and transistor Q19.

In normal mode, the set input of the bistable is held at logic 1 by S4 d, which maintains the Q output at logic 1 and truns off transistor Q19. Q20 is then driven normally by Q18.

In single sweep mode, the set input of U3 B is held at logic 0 by R108. Operation then depends on the initial conditions of the circuits.

a) Free-run mode

If the sweep is in free-run mode, when the SINGLE SWEEP push-button is depressed the signal produced when the lower threshold is reached simultaneously resets the two bistables U3 A and U3 B to zero. The Q output of U3 B is at logic 1 and makes Q19 saturate, preventing U3 A and Q18 from switching Q20 ; the ramp falls until transistor Q24 saturates, and stays saturated.

When RESET button S6 is pressed C29 discharges a positive pulse into the set input of bistable U3 B. The Q output of U3 B switches to logic 1, cuts off Q19 and Q20 and makes the sawtooth fly back.

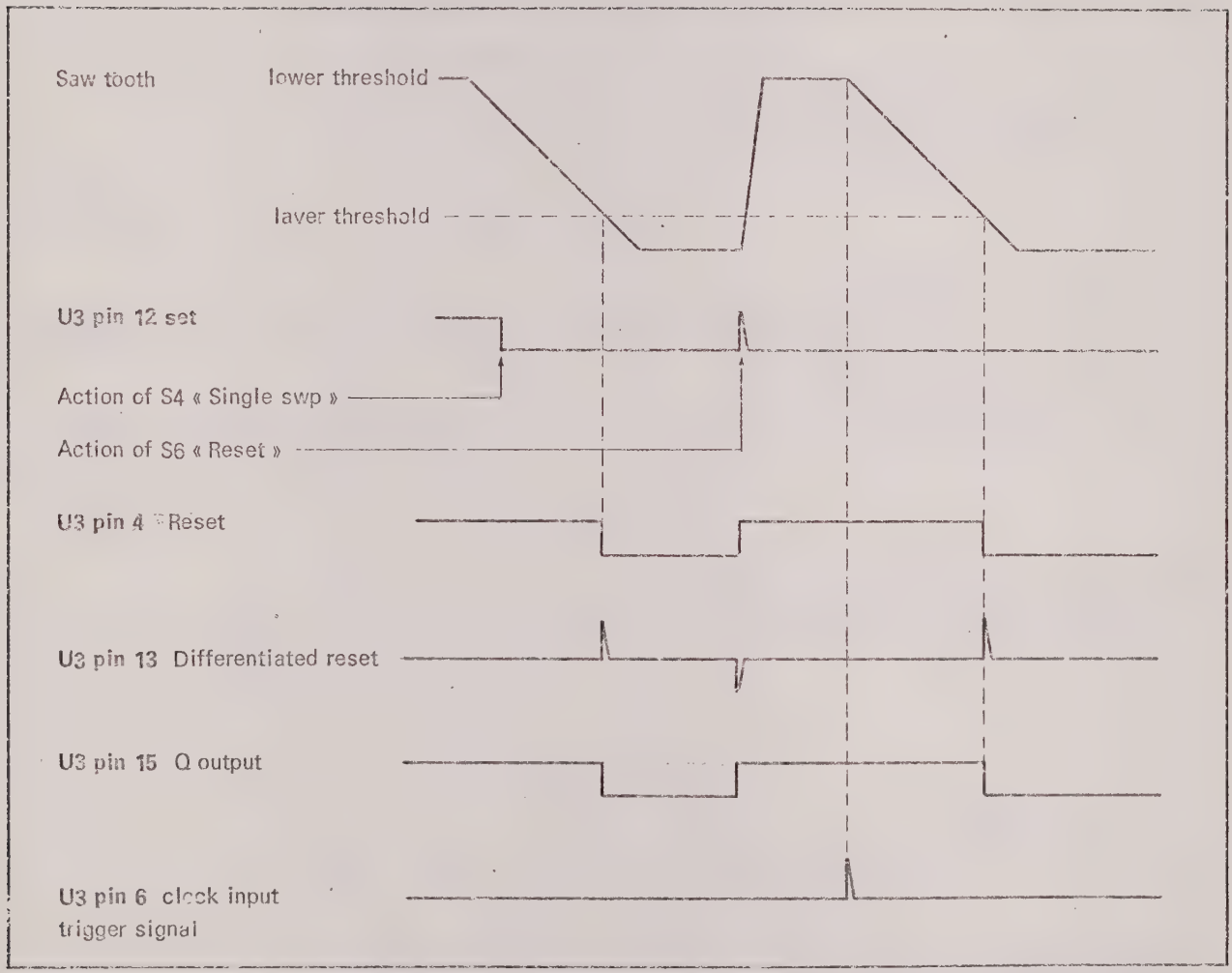
A fresh sweep can then be initiated by the arrival of a trigger pulse at the clock input of U3 A (in triggered mode). At the end of the sweep, the 2 bistables are again reset and no further sweep can take place.

b) Triggered mode, without signal

The sawtooth is at the start point. Bistable U3 B receives no reset pulses ; it is automatically set and the sweep is initiated by the first trigger pulse which follows the switching of S4 d to SINGLE SWEEP. As above, U3 B is reset at the end of this sweep. Push-button S6 must therefore be pressed in order to set the bistable and authorise a fresh sweep.

c) Reset lamp DS5002

In single sweep mode this lamp is lit when transistor Q14, which is common base configuration, conducts, that is when the $\overline{Q}$ output of U3 B is at logic 0. Whenever the time base is not armed, the lamp is out. It lights when the sweep has been reset by S6 and during the sweep.


Saw tooth
lower threshold
laver threshold
U3 pin 12 set
Action of S4 « Single swp »
Action of S6 « Reset »
U3 pin 4 Reset
U3 pin 13 Differentiated reset
U3 pin 15 Q output
U3 pin 6 clock input
trigger signal

Single sweep operation

3.3.4.- B2 trigger and time base (Fig. 6)

The majority of the B2 time base circuits are similar to B1 :

- the trigger signal input circuit is the same, with 1/10 attenuator, signal source selection (INT. or EXT.), selection of trigger edge (⟋ or ⟍) and of the coupling mode (DC or AC) ;
- the trigger circuit is the same (Q28 - Q29 - Q30 - Q31) but without the "AUTO" system ;

- the B2 time base is the same (except that there is no vernier for hold-off) with :

  . sweep control bistable U6 A

  . Miller integrator (Q45 - Q46)

  . sweep fly-back system with threshold circuits U5 and U7. Only the circuit for controlling B2 sweep, from the B1 sawtooth via a delay circuit, is different.

3.3.4.1. - Delay circuit

The delay circuit consists of differential amplifier U4 followed by Schmitt trigger Q33 - Q34 (see schematic on next page).

Integrated circuit U4 is wired as a differential amplifier supplied by a current generator. The circuit only receives power (on pin 13), via S4 b. when the latter is in the B2 or MIXED positions.

3.3.4.2. - B2 sweep control

B2 sweep is controlled by double bistable U6 and transistor Q43 : it starts as soon as Q43 conducts, namely as soon as bistable U6 A switches to logic 1 (Q output at logic 0). U6 A can only switch when its D input is at logic 1 forced by the Q output of bistable U6 B.

- STARTS AFTER DELAY position of S6001 :

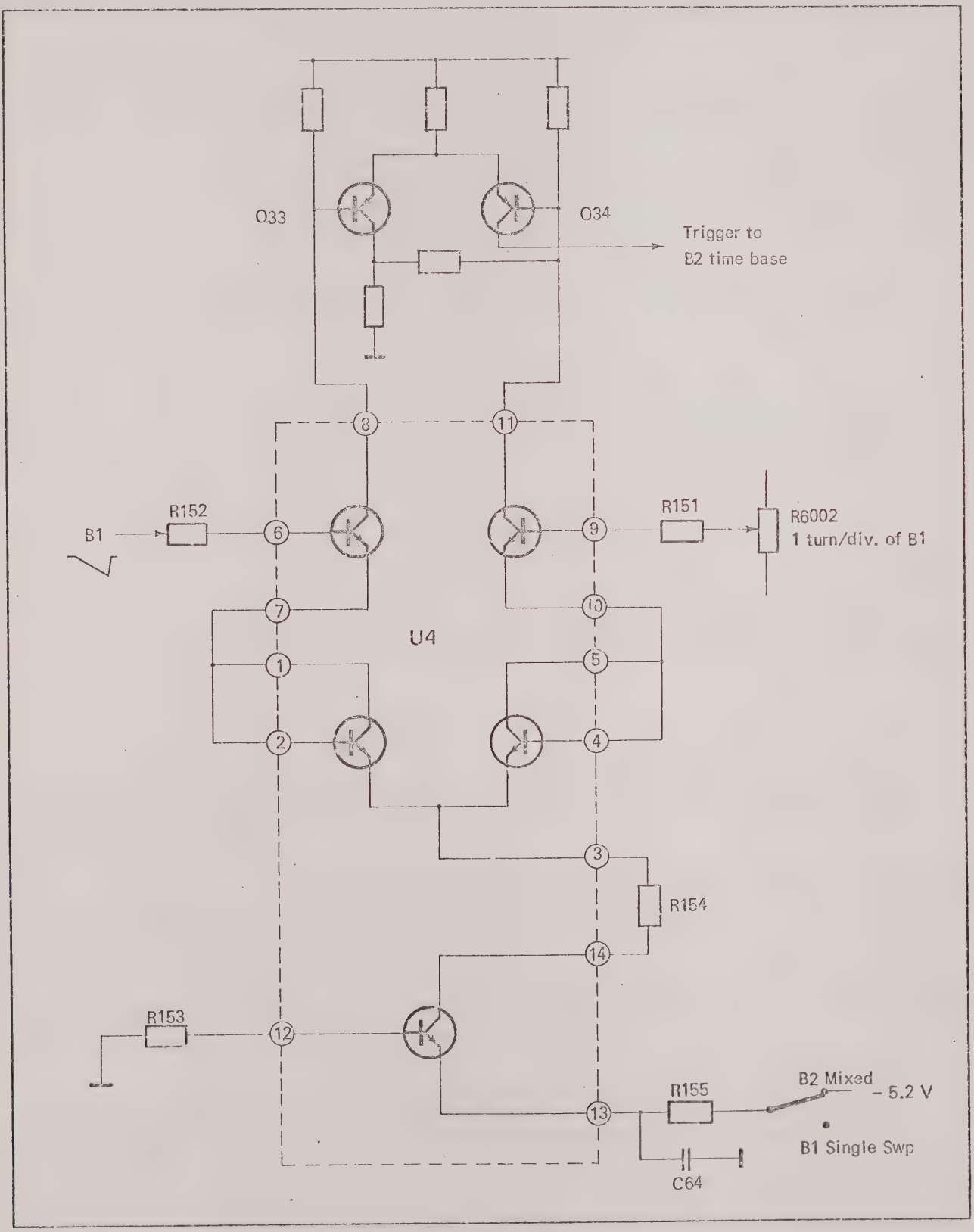
  . gate U5-14 is closed and blocks the trigger signal

  . gate U5-3 is open and gates the signal from the delay circuit through to the clock input of bistable U6 A

  . bistable U6 B is held at logic 1 by means of its set input pin 5, and allows U6 A to switch. U6 A initiates B2 sweep on the trailing edge of the delay circuit pulse.

- other positions of S6001 (triggered)

  . gate U5-3 is closed but gate U5-14 is open and routes the trigger signal to the clock input of bistable U6 A.



Delay circuit U4

. the signal to the set input of U6 B is inhibited : as long as this bistable is at logic 0, bistable U6 A is inhibited by its D input ; the trigger pulses have no effect. When the trailing edge of a pulse from the delay circuit arrives, this makes U6 B switch to logic 1, enabling U6 A to switch as soon as the next trigger pulse arrives, and initiate B2.

At the end of the sweep (B2 or B1), both U6 bistables are reset when the lower threshold is detected. A fresh sweep can be initiated.

3.3.4.3.- Fly-back to the start point voltage

- In the "B1", "B2", "B1 + B2" and "single sweep" mode, the start point voltage is defined by R204 and R205 : when it is reached transistors Q40 and Q41 conduct and form a loop round the Miller amplifier, thus locking its output voltage.
- In "mixed" mode, the start point voltage is replaced by the B1 sawtooth. As long as B2 time base is not initiated, the Miller integrator follows the start point voltage : its output therefore follows B1 sawtooth voltage. As soon as the B2 integrator is initiated transistors Q40 and Q41 are out off : the slope of the sawtooth is then defined by the R and C components switched by S501 b.

3.3.4.4.- Bright-up

The bright-up pulse is supplied by a level-matching amplifier consisting of transistors Q36 and Q37. It drives the amplifier on power supply circuit board Z1 (fig. 3).

When Q36 conducts alone, the output level corresponds to normal brightness of the trace. When Q36 and Q37 conduct simultaneously the level supplied intensifies the trace brightness.

These two transistors are driven by double bistable U8 and gates U5-2, U7-3 and U7-14, according to the sweep mode selected by push-button switch bank S4.

The U8 bistables are disabled when their D input is at logic 0. When their D input is at logic 1, they switch when the B1 sweep control signal arrives on their clock input. Their Q output then drives Q36 into conduction via gate U7-14.

U8 A is reset to zero by the B1 reset signal.

U8 B is reset to zero by the B1 and B2 reset signal.

Gate U5-2 is only open in the "B1 + B2" and "B2 only" modes, and gate U7-3 receives the B2 sweep control signal. During the B2 sweep U5-2 drives Q36 into conduction and U7-3 drives Q37 into conduction.

Operation in the different sweep modes is summarised in the following table :

Mode	B2 sweep control		D	B1 sweep control		
	U5-2	U7-3		U8-A	D	U8-B
B1 only	closed		1	Q = 1 → Q36 conducts	0	disabled
B1 + B2	open	Q37 conducts	1	Q = 1 → Q36 conducts	0	disabled
B2 only	open Q36 conducts	Q37 conducts	0	disabled	0	disabled
Mixed	closed	open Q37 conducts	0	disabled	1	Q=1 → Q36 conducts

Transistors Q35 and Q36 are buffers which supply the bright-up pulses from B1 and B2 to the "⊓ B1" and "⊓ B2" outputs (J601 - J602 on the rear panel).

3.3.5. - Sweep mode selector S4 (Fig. 7)

B1 (button S4 a depressed only)

- the B1 sawtooth is applied to the X amplifier input and drives the sweep
- B2 time base does not operate.

B1 + B2 (buttons S4 a and S4 b depressed)

- B1 sawtooth is connected to the input of the X amplifier as in the previous cas and drives the sweep
- the delay circuit is powered and triggers B2 time base but the B2 sawtooth is not routed to the X amplifier input. The B2 bright-up pulse intensifies part of the trace, whose position depends on the delay selected and on the ratio between the B1 and B2 sweep rates.

B2 only (button S4 b depressed only)

- the delay circuit is powered and triggers B2 time base : the part of the trace that was previously intensified is now displayed on the whole width of the screen.
- since button S4 a is released, B2 sawtooth is applied to the input of the X amplifier and provides the sweep.

Mixed (button S4 c depressed)

- the B2 output is connected to the X amplifier input : as long as the B2 integrator is not triggered it follows the B1 output, and thus B1 provides the sweep. As soon as the B2 integrator is triggered the B2 sweep is displayed.

  The first part of the trace is thus swept at the B1 rate, and then, starting at a point defined by delay control R6002, the remainder of the trace is swept at the B2 rate.

Single sweep : see operation on page 44

3.3.6. - X amplifier (Fig. 7)

The horizontal amplifier is driven by the sawtooth signal from B1 or B2 time bases, or by the "X amplifier" signal applied to the input terminal of the B2 trigger circuit (fig. 6).

The amplifier outputs are connected to the horizontal deflection plates of the cathode ray tube.

When selector switch S501 a is in the XY position, diode gate CR35 - CR36 routes the X signal to the base of transistor Q51. The X mode selector, S4, routes the B1 or B2 sweep sawtooth to the base of Q48 for all the other positions of S501 a.

Transistors Q48 and Q51 are a shunt feedback amplifier and drive the balancing amplifier stage consisting of Q49 and Q50. R256 and R269 are the feedback resistors.

The X1, X10 expansion is applied in this stage by gain variation. The "X1 - X10" switch S5 switches gain resistors R264, R266 or R265, R267. Potentiometers R265 and R266 provide X1 and X10 gain adjustment.

The signals from the collectors of Q49 and Q50 are passed to the output stage of the amplifier which consists of two followers Q53 and Q54 and the two shunt feedback amplifiers Q52 and Q55.

C88 and C90 provide high frequency compensation.

Potentiometer R260 centres the amplifier in X10 gain.

Potentiometer R254 centres the amplifier in XY mode. Potentiometer R253 centres the amplifier for all the other positions of the "time/div." switch S501 a.

3.4. - MAIN CHASSIS - PRINTED CIRCUIT BOARD Z3 (Fig. 2 and 3)

The following items are mounted on the chassis :

- the CRT and its associated circuits, in particular the EHT supply and the bright-up amplifier
- the low voltage power supplies
- the calibrator.

3.4.1. - Cathode ray tube and EHT converter (Fig. 3)

An HF oscillator operating at a frequency of about 20 kHz supplies the regulated voltages required by the CRT, namely :

- post-deflection acceleration (cathode - anode) : 13.6 kV
- quadripole lenses : + 835 V

- cathode and Vg2 : - 1475 V
- control grid drive voltage : - 1600 V.

Transistor Q13 with transformer T1 form the oscillator : one primary winding is in the collector circuit, and a primary feedback winding in the base circuit.

Stage Q9 - Q10 is the regulation amplifier ; it drives series regulator transistor Q12 via follower Q11.

This arrangement regulates as follows : the output voltage from the EHT converter is sampled by a resistive divider R35 to R39 and applied to Q9 base ; this acts on the DC voltage supplied by Q12. The EHT is adjusted by potentiometer R34.

Fuse F1 protects the converter power circuit.

The bias voltages are also derived from the voltages obtained on the secondary winding of T1. These are for :

- astigmatism electrode g4 : adjusted by R66
- post-deflection acceleration electrode g6 : this voltage is obtained by means of capacitor-diode multiplier cells
- the X quadripole : voltages adjusted by potentiometers R59 and R103
- the Y quadripole : voltage adjusted by R104
- electrode g5 : this voltage is adjusted by R62 which corrects geometrical distortions of the CRT
- control grid g1 : voltage adjusted by "brillance" control R75 which sets the beam intensity.

3.4.2. - Bright-up amplifier (Fig. 3)

This amplifier modulates the CRT beam intensity, and is driven by signals from B2 time base, from the trace blanking circuit and from the "external modulation" input.

All these signals arrive on the emitter of transistor Q14, which is a common base amplifier. Its collector drives emitter follower Q16, which in turn drives complementary output amplifier Q17 - Q18. Diode CR32 protects the amplifier against excessive external modulation signal amplitude.

The gain of the stage is determined by the feedback circuit consisting of C40, R112, R96, C48, R113.

The amplifier bias voltage is supplied by transistor Q15, and adjusted by R89.

The output pulse from this amplifier is superimposed on the bias voltage of the CRT control grid.

3.4.3. - Low voltage power supply

A single transformer, T201, provides all the voltages for these power supplies.

The primary is powered by the 110 V or 220 V line via voltage selector S201 which incorporates the fuses.

The secondary windings provide :

- 12.6 V for heating the CRT filament
- non-regulated + 140 V and + 20 V DC lines
- the + 50 V, + 14 V and - 5.2 V lines which are obtained after rectification, filtering and regulation ; the + 14 V line is the reference for the other supplies.

Regulators

The + 14 V line is regulated by integrated circuit U2 with ballast transistor Q3. U2 contains the error amplifier and the protection device and also generates the reference voltage.

The voltage is adjusted by potentiometer R11.

The + 50 V line is regulated by integrated circuit U3 with ballast transistor Q4. U3 is driven on one input by the reference voltage set by R18 - R19, and on the other input the voltage proportional to the + 50 V as defined by R16 - R17, and develops the error voltage which drives Q4.

The - 5.2 V line is regulated in the same way by integrated circuit U1 which drives ballast transistor Q2 via emitter follower Q1.

3.4.4. - Calibrator (Fig. 2)

Integrated circuit U4 is wired as an oscillator whose frequency is defined by R24 and C11. Its output is shifted in level by Q6 and then applied to amplifier Q7 - Q8. This amplifier drives a 20 mA current squarewave through loop J202 at which point a 600 mV voltage squarewave is obtained with respect to ground.

3.5. - DESCRIPTION OF INTEGRATED CIRCUIT A250 (see block diagram on page 29)

The A250 HF amplifier is a linear integrated circuit comprising :

- a differential amplifier
- an inhibit circuit for this amplifier, used for channel switching
- a trigger signal pick-off amplifier
- polarity switching

Connections

- the input signals are applied to pins 14 and 15
- the input circuit is biased negative by application of a voltage of - 6 V on pin 13 or of a symmetrical current on pins 11 and 12
- the components for defining the gain and for frequency compensation are connected between pins 11 and 12
- the amplifier is centred by means of pins 4 and 5
- pin 16 must be connected to a DC voltage which corresponds to the mean level of the input signals
- the gain is increased by a factor of 2.5 by passing a current of 36 mA into pin 8
- the inhibit command is applied to pin 1
- polarity switching is obtained by applying a voltage of + 9.6 V with respect to pin 16, to pin 10 (Normal) or to pin 9 (Inverted)
- the differential signal output is on pins 2 and 3
- the differential trigger output is on pins 6 and 7.

4. - MAINTENANCE

VERY HIGH VOLTAGES WHICH CAN CAUSE DEATH ARE PRESENT INSIDE THIS INSTRUMENT. EXTREME CARE MUST BE TAKEN TO AVOID ACCIDENTS WHEN WORKING WITH THE COVERS REMOVED.

The object of this chapter is to provide information for trouble-shooting or re-adjustment of the instument.

The calibration of the unit should be checked about every 1000 hours of operation.

4.1. - UPKEEP OF THE FRONT PANEL

The front panel can become dirty in use. To clean it, unscrew all the potentiometer and switch knobs and wash the silkscreened panel with soapy water. DO NOT USE ANY PRODUCT BASED ON PETROL, TRICHLOROETHYLENE, BENZINE OR ALCOHOL which will attack the paint and the silk screened legends.

4.2. - EQUIPMENT REQUIRED FOR CALIBRATION AND TROUBLE-SHOOTING

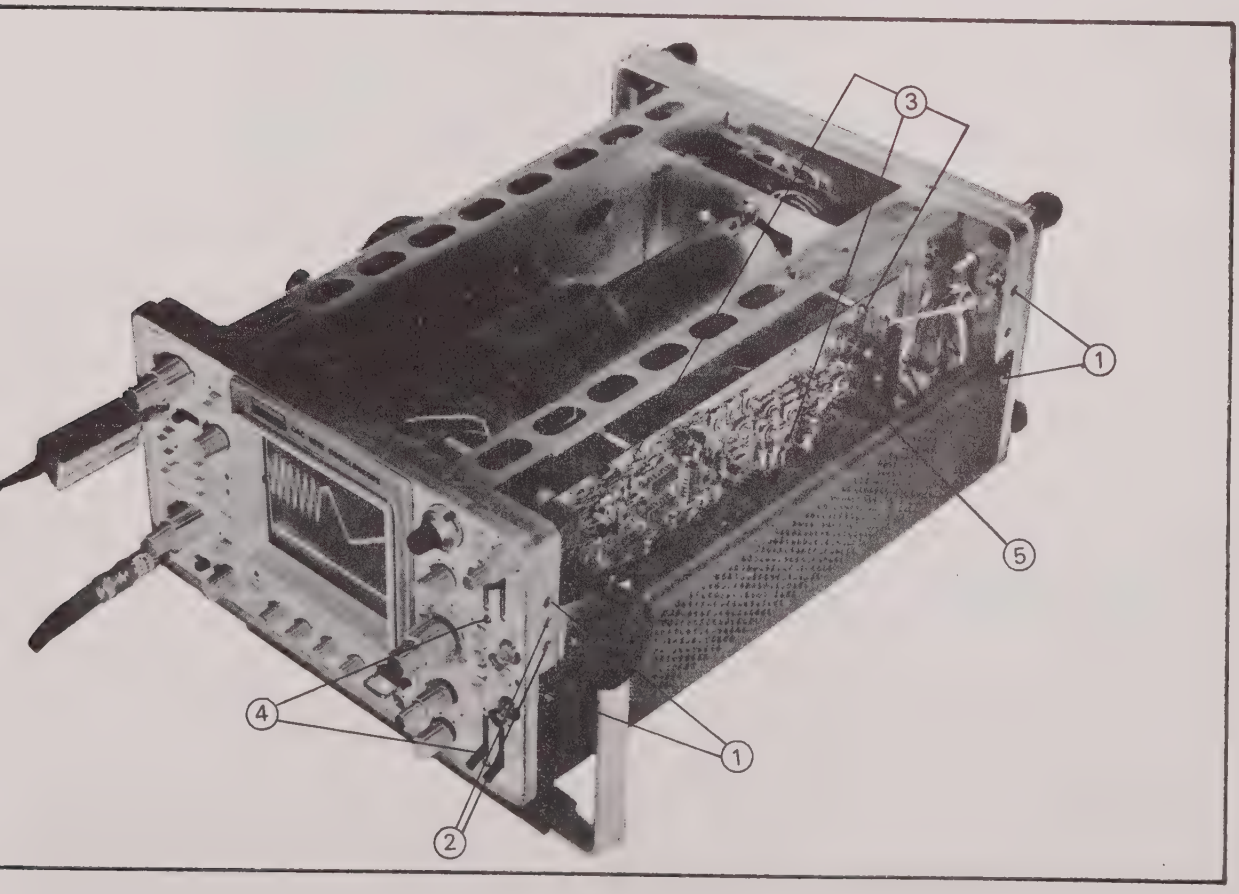
Instrument	Minimum performance required
Test oscilloscope, calibrated, with probe (CRC 5212 or CRC 5242)	bandwidth : 50 MHz
Electrostatic voltmeters	25 000 V and 2 000 V
Digital multimeter (VM 1240 or VM 4440)	accuracy 0.1 %
Time mark signal generator (GET 635)	period : 1 s to 0.2 µs
Pulse generator (GI 634 B)	rise time < 1 ns - flat pulse top - repetition rate : 1 Hz to 100 kHz
Pulse generator	rise time : 10 ns repetition rate : 100 kHz amplitude : 0 to 50 V

HF sinewave generator	50 kHz to 100 MHz
LF sinewave generator (4419 or 4420)	0 to 100 kHz
Calibrated amplitude squarewave generator	accuracy : 1 % voltage : 2 mV to 100 V peak to peak repetition rate : 1 kHz approx.
Adapters (2)	50 Ω
Attenuators	6 dB - 10 dB - 20 dB

4.3. - DISMANTLING

4.3.1. - Removal of the covers

- Remove side screws (1) : the upper cover is fixed with 4 screws. For the lower cover, remove the 4 side screws (1) and the 4 feet underneath.



4.3.2. - Removal of the carrying handle

The carrying handle must be removed before the subassemblies and the chassis can be dismantled. Remove it by taking out 2 screws (2) on each side.

4.3.3. - Removal of the X subassembly (Z2)

- Remove the 5 front panel knobs of this subassembly. To do this, take off the knob cap, loosen the nut inside and pull off the knob. For the "time/div." knobs, take off the blue knob cap, loosen the nut inside and take off the first knob ; pull off the washer between the 2 knobs and then the second knob ; loosen the screws on the B2 dial and pull the assembly forwards.
- Remove 2 screws (4) on the front panel under the "trigger" lever switches.
- Disconnect the printed circuit connecter (5) and the 2 connections to the X plates of the CRT.
- Remove screws (3) ; two are on the upper girder and two are on the circuit board : one beside test point TP4 and the other in the lower right-hand corner.
- Free the printed circuit board towards the rear and disconnect the 3 connecting cables to circuit board Z3 (Y subassembly). The circuit board can now be removed completely from the chassis.

4.3.4. - Removal of the Y subassembly (Z3)

- Remove the 4 "V/div." and " ⇕ " knobs and the switch retaining nut.
- Disconnect the Z3 printed circuit connector and the V signal output cable.
- Take out the 4 fixing screws for the circuit board.
- Disconnect the connecting cables to the Y plates of the CRT.
- Extract the Y subassembly by pulling it back and down.
- Disconnect the 3 connecting cables to the X subassembly as soon as they are accessible, and then remove the circuit board completely.

4.3.5. - Removal of the power supply circuit board Z1

- Take off the 4 knobs of the BRILLIANCE, ASTIG., FOCUS and SCALE ILLUMINATION controls on the front panel.
- Remove the grey protecting plate that is held in place by 4 screws
- Disconnect the calibrator output connecter (at the front), and the post-deflection acceleration electrode connecter.
- Take off the CRT base socket : to do this remove the protecting plate which is held in place by 2 screws on each side of the CRT.
- Remove the connectors to the other circuit boards and to the V output (rear panel).
- On the rear panel, remove the 4 screws (a) (see plate P1) and the 4 feet.
- Pull the rear panel and circuit board Z1 subassembly to the rear.

4.3.6. - Removal of the CRT

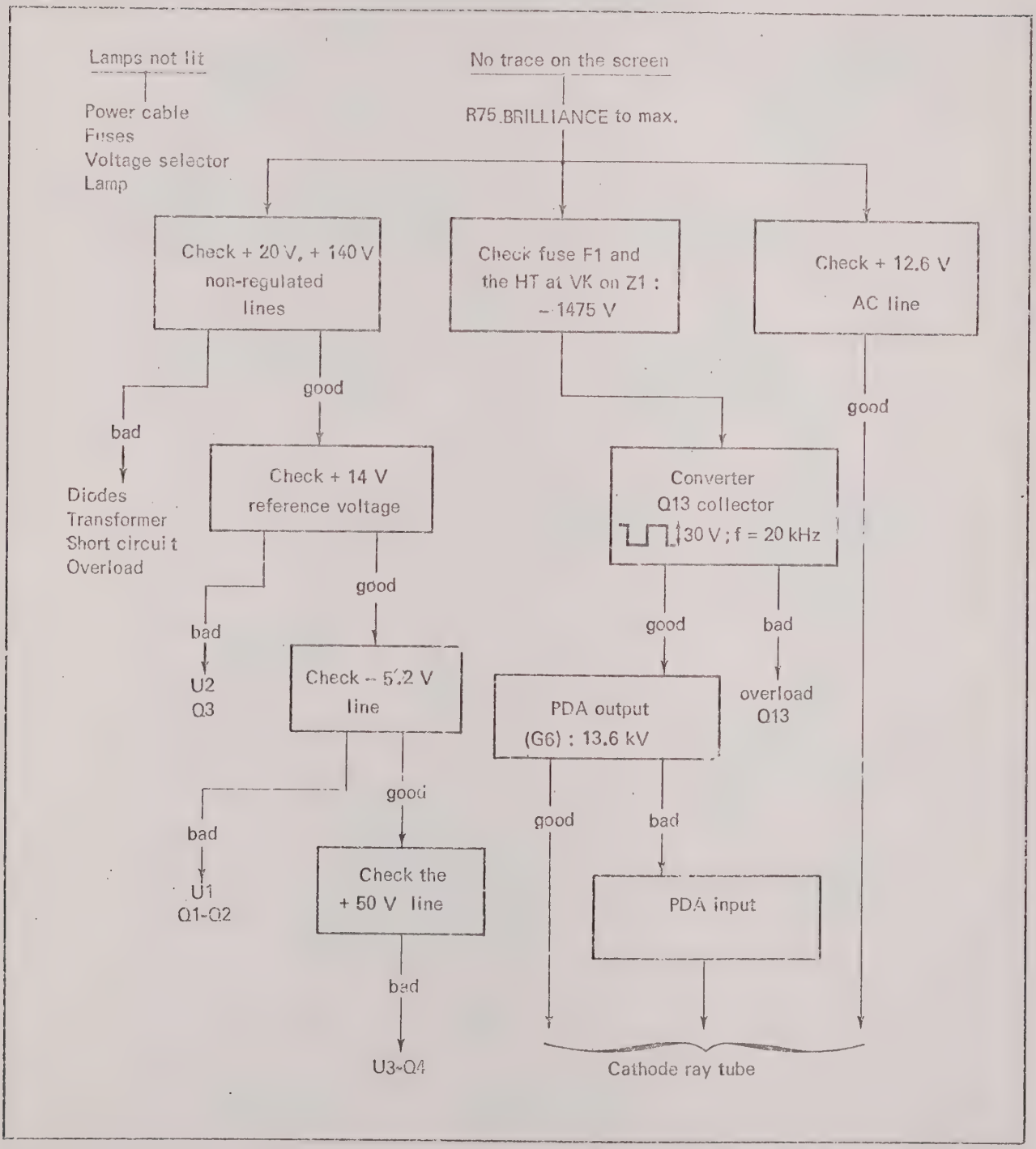
- Remove the connections to the X and Y plates and to the PDA electrode, at the printed circuit end.
- Remove the protecting plate and then the CRT base socket.
- Unsolder the trace rotation and scale illumination wires (at the front of the tube).
- Remove the scale illumination circuit support by unscrewing the two side screws.
- Remove the 4 screws that retain the rear angle bracket.
- Pull the tube out towards the rear, lifting it slightly.

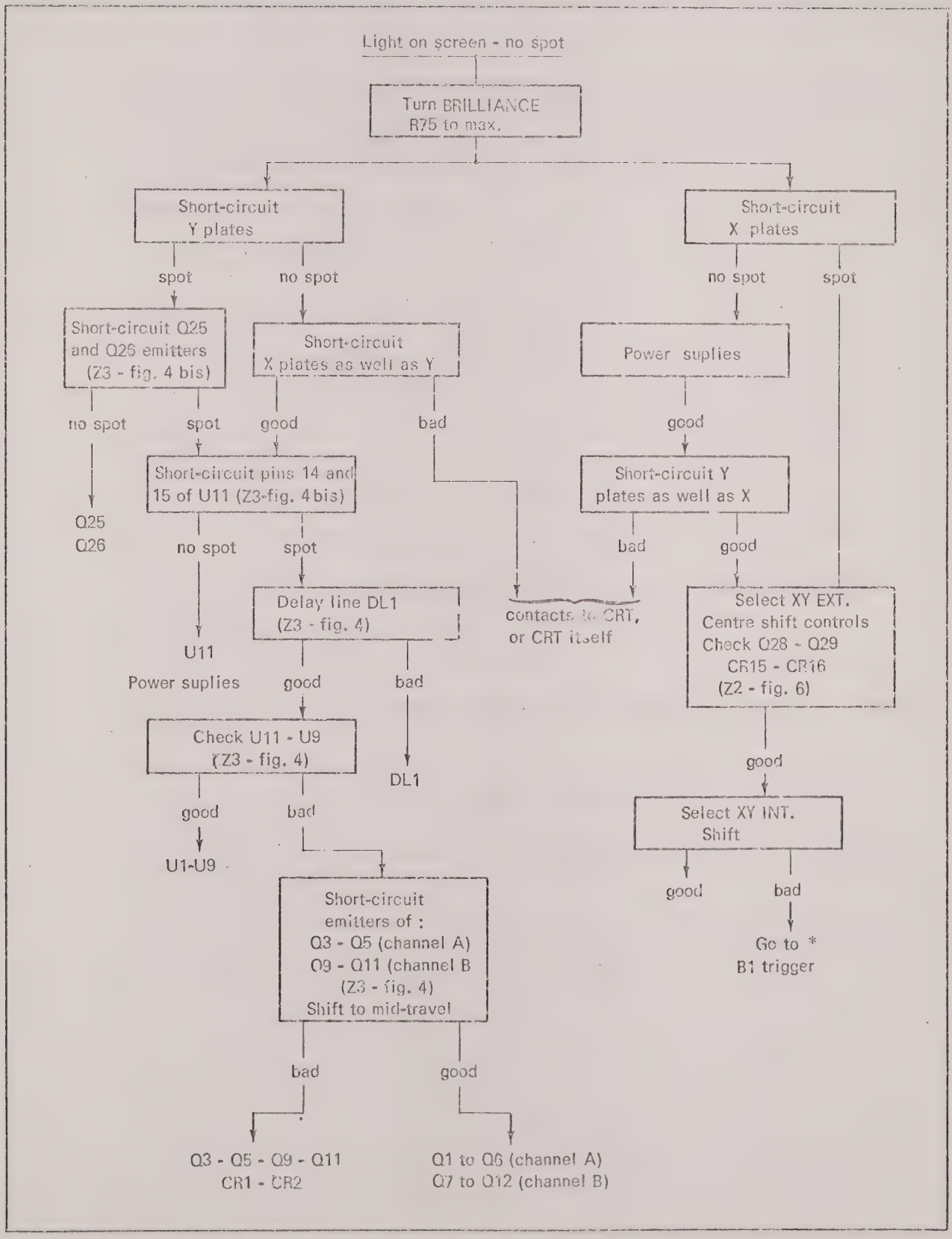
4.4. - TROUBLE-SHOOTING

If the instrument is not working correctly, first of all inspect all the wiring and the circuit boards and make sure that there are no broken or unsoldered wires, that all the transistors, integrated circuits and connecters are properly plugged in, etc..

The following pages give trouble-shooting procedures for some types of fault.

4.4.1. - Lamps and cathode ray tube extinguished




Light on screen - no spot
Turn BRILLIANCE R75 to max.
Short-circuit Y plates
spot
no spot
Short-circuit X plates
no spot
spot
Short-circuit Q25 and Q26 emitters (Z3 - fig. 4 bis)
Short-circuit X plates as well as Y
Power suplies
no spot
spot
good
bad
good
Short-circuit pins 14 and 15 of U11 (Z3-fig. 4 bis)
Short-circuit Y plates as well as X
Q25
Q26
no spot
spot
bad
good
Delay line DL1 (Z3 - fig. 4)
contacts to CRT, or CRT itself
Select XY EXT. Centre shift controls Check Q28 - Q29 CR15 - CR16 (Z2 - fig. 6)
U11
Power suplies
good
bad
Check U11 - U9 (Z3 - fig. 4)
DL1
good
Select XY INT. Shift
good
bad
U1-U9
good
bad
Go to * B1 trigger
Short-circuit emitters of : Q3 - Q5 (channel A) Q9 - Q11 (channel B (Z3 - fig. 4) Shift to mid-travel
bad
good
Q3 - Q5 - Q9 - Q11 CR1 - CR2
Q1 to Q6 (channel A) Q7 to Q12 (channel B)

- Apply a 1 V amplitude signal from the calibrated generator to the B2 TRIGGER input J6001 and adjust the horizontal amplitude of the trace to 4 screen divisions with R272. If this adjustment shifts the trace, readjust R273 to bring it back to the centre.
- Turn S501 a back to 1 ms/div.

4.5.5. - B1 triggering (Z8 - fig. 5 - P3)

a) LEVEL control R5002 to AUTO

. S5001 to EXT. 1

. S5002 to AC (⎍ ou ⎍)

- Apply a 2 V peak to peak, 1 kHz sinewave to the B1 TRIGGER input J5001.
- Connect the probe of the test oscilloscope to test point TP1.
- Switch selector S5002 from ⎍ to ⎍ and adjust R25 so that the pulses have the same width in each of these positions.
- Reduce the input signal level to 80 mV peak to peak and adjust R23 so that the pulse width is the same for the two positions.
- Readjust R25 and then R23 if necessary.

b) Turn LEVEL control R5002 off the AUTO position

- Turn R5002 to one end of its travel.
- Increase the amplitude of the signal applied to J5001 until triggering is obtained.
- Turn R5002 to the other end of its travel and adjust R34 until triggering is obtained again.
- Repeat these two operations successively, varying the amplitude of the signal and adjusting R34 until correct triggering is obtained on the positive and negative half-cycles of the signal.

4.5.6. - B2 Triggering (Z2 - fig. 6 - P3)

. S4 to B2

. R5002 to AUTO

. S6001 to EXT. 1

. S6002 to AC

- Apply a 1 V peak to peak, 1 kHz signal to input J6001.
- Connect the test oscilloscope to TD4.
- Equalise the widths of the negative and positive pulses with LEVEL control R6003.
- Switch S6002 from ⎍ to ⎏ and equalise the widths of the positive and negative pulses with R139.
- Centre the action of the level control with R142.
- Finalise these adjustments for a minimum trigger amplitude of 80 mV.

4.5.7. - Bright-up amplifier (Z1 - fig. 3 - P5)

a) S4 to B1 : B2

. R5002 to AUTO

. S6001 to STARTS AFTER DELAY

. S501 a to 100 µs/div.

. S501 b to 10 µs/div.

- Connect the test oscilloscope probe to TP1 and adjust R89 to obtain a pulse with intensification pulse without saturation, and a base line level at 10 V.

b) S4 to B1

. S501 a to 0.1 µs

- Adjust the linearity of the bright-up on the tube with C40 (Z1).

4.5.8. - B1 time base (Z2 - fig. 5 and 7 - P3)

. S501 a to 10 µs/div.

. S4 to B1 + B2

. R5002 to AUTO

. S6001 to STARTS AFTER DELAY

a) Sawtooth start point voltage (Fig. 5)

- Connect the test oscilloscope to TP4.
- Check that the sawtooth returns properly to the start point voltage for all positions of TIME/DIV. selector S501 a.
- Adjust R78 so that the hold-off works on all ranges without oscillation of the start point voltage.
- Connect the time mark generator, set to 10 µs, to one of the Y inputs and trigger the display.
- Set R6002 to "1" turn and adjust R71 so that the second pulse is intensified.
- Turn R6002 to "9" and adjust R97 so that the tenth pulse is intensified.
- Repeat these two operations until a perfect result is obtained.

b) Horizontal amplifier (Fig. 7)

- Adjust R266 so that one pulse is obtained for each division.
- Select 1 µs on the time mark generator. Switch S5 to the X10 position and adjust R265 so that there is one pulse for each division.
- Set the generator to 10 µs and switch S5 to X1, then bring the sixth pulse to the centre of the screen with the shift control.
- Switch S5 to X10 : readjust R260 to bring the sixth pulse to the centre of the screen.
- Repeat these two adjustments successively until perfect balancing is obtained.

B1 sweep rates

- For each position of S501 a, set the time mark generator to a period that corresponds to the selected sweep rate and adjust the following components to give one pulse per division each time :

S501 a	component to be adjusted
1 µs	R116
0.1 µs	C509
0.1 ms	R115
10 ms	R114
1 s	R113

- Check the calibration of the intermediate positions of S501 a.

4.5.9. - B2 time base (Z2 - fig. 6 - P3)

. R5002 to AUTO
. S4 to B2
. S6001 to INT.
. B1 vernier R5003 b to UNCAL.

- Connect the test oscilloscope to TP9 and check that the sawtooth returns correctly to the start point voltage for all positions of TIME/DIV. selector S501 b.
- Adjust R212 for correct operation of the hold-off on each range and no start point voltage oscillation.
- Connect the time mark generator to one of the Y inputs and calibrate each position of S501 b in the same manner as before.

S501	component to be adjusted
10 µs	R235
1 µs	R247
0.1µ s	C606
0.1ms	R246
10 ms	R245

- Check the calibration of the intermediate positions of S501 b.

4.5.10. - Time base linearity (Z2)

For the fastest sweep rates (0.5 - 0.2 - 0.1 µs), with S5 in the X10 position, adjust the sweep linearity :

C82 : B1 time base (fig. 5)
C83 : B2 time base (fig. 6)
C88 and C90 : X output amplifier (fig. 7)

4.5.11.- Channel A and B balancing (Z3 - fig. 4 and 4 bis - P4)

a) Channel B

. TRIGGER selector S405 to "B"
. Y mode selector S3 to "B"

- Turn the shift control R85 (fig. 4) to display the trace on the screen.
- Adjust balance potentiometer R34 (fig. 4) which is accessible on the front panel, so that the trace does not move when VOLT/DIV. selector S404 and vernier R432 are turned through their different positions.
- Short circuit pins 6 and 7 of integrated circuit U9 and connect the multimeter between Q34 collector and ground (fig. 4 bis) : adjust R173 for a reading of 0 V.
- Connect the voltmeter between pins 4 and 5 of U9 and adjust shift control R85 for 0 V.
- Adjust R74 so that the collector voltage of Q34 does not change in value or sign when S2 is switched from N to INV. Set this voltage to 0 V with R173. The trace should not move by more than 2 mm when S2 is switched from N to INV.
- Centre the trace on the screen with R144 (output amplifier - fig. 4 bis).

b) Channel A

. TRIGGER selector S405 to "A"
. Y MODE selector S3 to "A"

- Bring the trace on to the screen with shift control R101.
- Adjust balance potentiometer R15 (fig. 4 - front panel) so that the trace does not move when V/div. selector S403 and vernier R422 are turned.
- Connect the multimeter between pins 4 and 5 of integrated circuit U1 and set this voltage to 0 V with shift control R101.
- Centre the trace on the screen with R45 (fig. 4) and adjust potentiometer R155 (fig. 4 bis) so that the collector of Q34 is at 0 V.
- Switch S1 to "X5" without touching the shift : centre the trace with R203 (fig. 4).

4.5.12. - Channel A and B gain

a) Channel A gain

. TRIGGER selector S405 to "A"
. Y MODE selector S3 to "A"
. V/DIV. selector S403 to 5 mV/div.
. Vernier S422 to CAL.

. S1 to X5

- Apply a 5 mV peak to peak to signal to A input J401.
- Adjust R130 (output amplifier - fig. 4 bis) so that the displayed amplitude on the screen is 5 divisions.

. S1 to X1

- Apply a 20 mV peak to peak signal to A input J401.
- Adjust potentiometer R49 (fig. 4), which is accessible on the front panel, so that the displayed trace amplitude on the screen is 4 divisions.

b) Channel B gain

. TRIGGER selector S405 to "B"
. Y MODE selector S3 to "B"
. V/DIV. selector S404 to 5 mV/div.
. Vernier R438 to CAL.

- Apply a 20 mV peak to peak signal to B input J402 and adjust R77 (front panel - fig. 4) for a displayed trace amplitude on the screen of 4 divisions.

4.5.13. - "Trigger view" circuit (Z3 - fig. 4 - P4)

a) . TRIGGER and Y MODE selectors S405 and S3 to "B"
. Shift control R85 : trace centred
. B1 TRIGGER selector S5002 to DC
. B1 TRIGGER selector S5001 to EXT. : press the "trigger view" push-button of S405 and centre the trace with R67.
. B1 TRIGGER selector S5001 to INT. : press the "trigger view" push-button and re-centre the trace if necessary with R173 (fig. 4 bis).

b) . TRIGGER and Y MODE selectors S405 and S3 to "A"
. Shift control R101 : trace centred.

Press the "trigger view" push-button and re-centre the trace if necessary with R155 (fig. 4 bis).

4.5.14. - XY Mode (Z3 - fig. 4 bis - P4)

. TIME/DIV. selector S501 a to "XY"
. B1 TRIGGER selectors : S6001 to XY
S6002 to INT. (XY)
. Shift control : spot sentred

a) TRIGGER selector S405 to A and Y MODE selector S3 to B

. Volt/div. selector S403 to 5 mV
. Vernier R422 to CAL.

- Centre the spot with the shift controls :
R101 (channel A) in X
R85 (channel B) in Y

Apply a 20 mV signal to the A input and adjust potentiometer R160 (fig. 4 bis) so that the horizontal trace has an amplitude of 4 divisions.

b) TRIGGER selector S405 to B and Y MODE selector S3 to A

. Volt/div. selector S404 to 5 mV
. Vernier R432 to CAL.

- Centre the spot with the shift controls :
R85 (channel B) in X
R101 (channel A) in Y

- Apply a 20 mV signal to B input J402 and adjust R169 (fig. 4 bis) so that the horizontal trace has an amplitude of 4 divisions.

4.5.15. - Frequency correction of vertical preamplifiers
(Z3 - fig. 4 and 4 bis - P4)

a) Channel B

. TRIGGER selector S405 and Y MODE selector S3 to "B"

. Volt/div. selector S404 to 20 mV/div.
. Vernier R432 to CAL.

- Fit a 50 Ω termination to the B input and connect the fast-rise pulse generator (GI 634 + 6 dB attenuator).

- Adjust the following time constants so as to obtain a pulse with a minimum of irregularities on the top (overshoot on the first 50 nanoseconds of less than ± 5 %, irregularities thereafter less than ± 2 %). The calculated rise-time is less than 4.1 ns.

R81	-	C31	(fixed)	(
R79	-	C29		) channel B preamplifier - fig. 4
C28				(
R124	-	C41	(fixed)	(
*R125	-	C42	(fixed)	) output amplifier fig. 4 bis
R126	-	C43		(
R127	-	C44		)
C45				(
R100	-	C55		)

*R125 should be adjusted in CHOP. mode (S3)

b) Channel A

. TRIGGER selector S405 and Y MODE selector S3 to "A"
. Volt/div. selector S403 to 20 mV
. Vernier R422 to CAL.

- Connect the pulse generator to the A input.

- Adjust the following time constants as for channel B :

R50	-	C20	(fixed)	(
R51	-	C21		) channel A preamplifier
C19				(

- Readjust if necessary the time constants of the output amplifier that were adjusted using channel B and obtain the best compromise between the 2 settings.

c) Bandwidth check

Measure the bandwidth on channels A and B : it should be 85 MHz for the ranges between 5 mV and 5 V/div. and 15 MHz for the 1 mV/div. range.

4.5.16. - Frequency correction in XY mode

a) Channel A in X

. TRIGGER selector S405 to "A"
. Y MODE selector S3 to "B"
. VOLTS/DIV. selector S403 to 20 mV
. Vernier R422 to CAL.
. TIME/DIV. selector S501 to XY
. B2 TRIGGER selector to INT. (XY)

- Connect the output of the fast-rise pulse generator to channel A input and the sweep sawtooth from the test oscilloscope to the channel B input. The test oscilloscope is triggered by the TRIGGER output of the generator. In this way a vertical sweep is obtained.
- Correct the shape of the pulse obtained by adjusting C52.
- Check that the bandwidth to - 3 dB is 2 MHz and that the phase error between signals applied to channels A and B is less than 3° at 100 kHz.

b) Channel B in X

. TRIGGER selector S405 to "B"
. Y MODE selector S3 to "A"
. VOLTS/DIV. selector (B) S404 to 20 mV
. Vernier R438 to CAL.

- Connect the fast-rise pulse generator output to channel B input and the test oscilloscope sweep sawtooth to channel A input.
- Correct the shape of the pulse obtained by adjusting C52.
- Check that the bandwidth to - 3 dB is 2 MHz and the phase error 3° at 100 kHz.

4.5.17. - Attenuators

Connect the fast-rise pulse generator to the channel A and B inputs and carry out the following adjustments so as to eliminate any imperfections in the displayed pulse shape.

Attenuator position	Adjustments	
	Channel A	Channel B
100 mV	C404	C405
1 V	C407	C417

Input capacitance correction

- Connect an amplitude calibrated generator to the oscilloscope input via the 50 020 probe ; adjust the probe correction.
- Then correct the various attenuator positions with the probe :

Attenuator position	Adjustments	
	Channel A	Channel B
50 mV	C402	C412
100 mV	C403	C413
1 V	C410	C418

4.5.18. - Auxiliary input and output signal checks

a) External modulation input (rear panel)

Apply a 5 V signal to MOD. EXT. input J301. Check the beam modulation (see specification, page 8)

b) SIGNAL V output (rear panel)

Check that the following are available on output J403 :

- the signal on channel A or B if Y MODE is set to "A" or "B"
- the A signal followed by the B signal if Y MODE is set to "ALT."
- the A ± B signal when the Y MODE is set to A + B (with S2 set to N or INV.).

This signal should have an amplitude of 25 mV per division into a 50 Ω load (see specification, page 3).

c) B1 and B2 ⌐¬ outputs (rear panel)

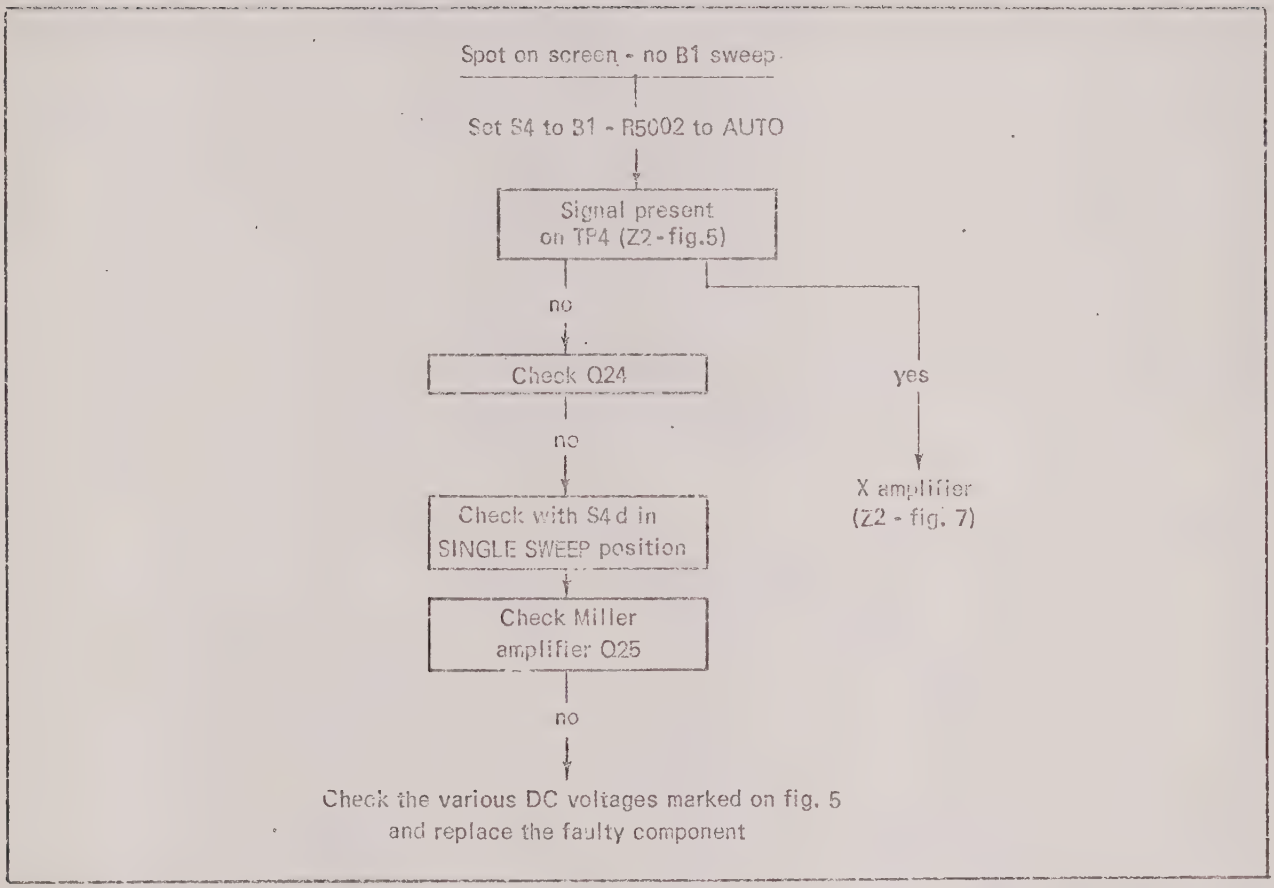
Check that the B1 and B2 time base bright-up pulses are available on outputs J601 and J602. The pulse amplitude is 5 V (see specification, page 9).

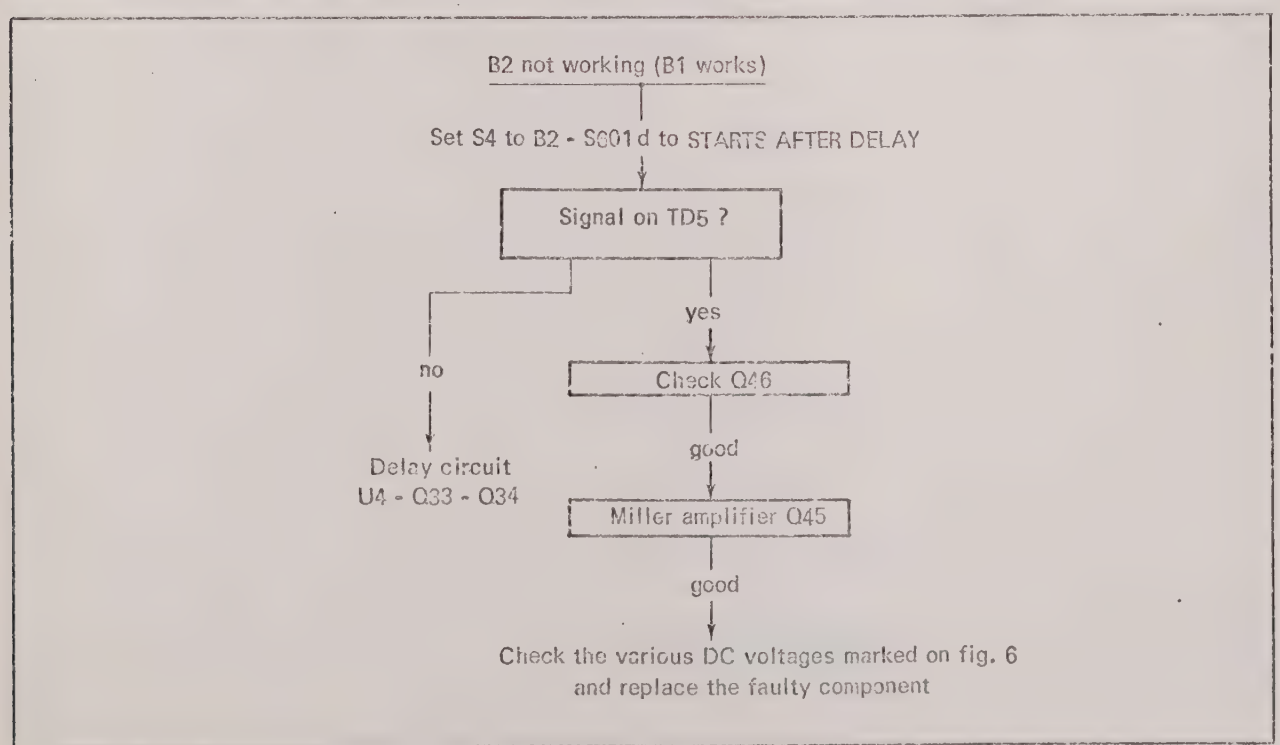
d) CALIBRATOR output (front panel)

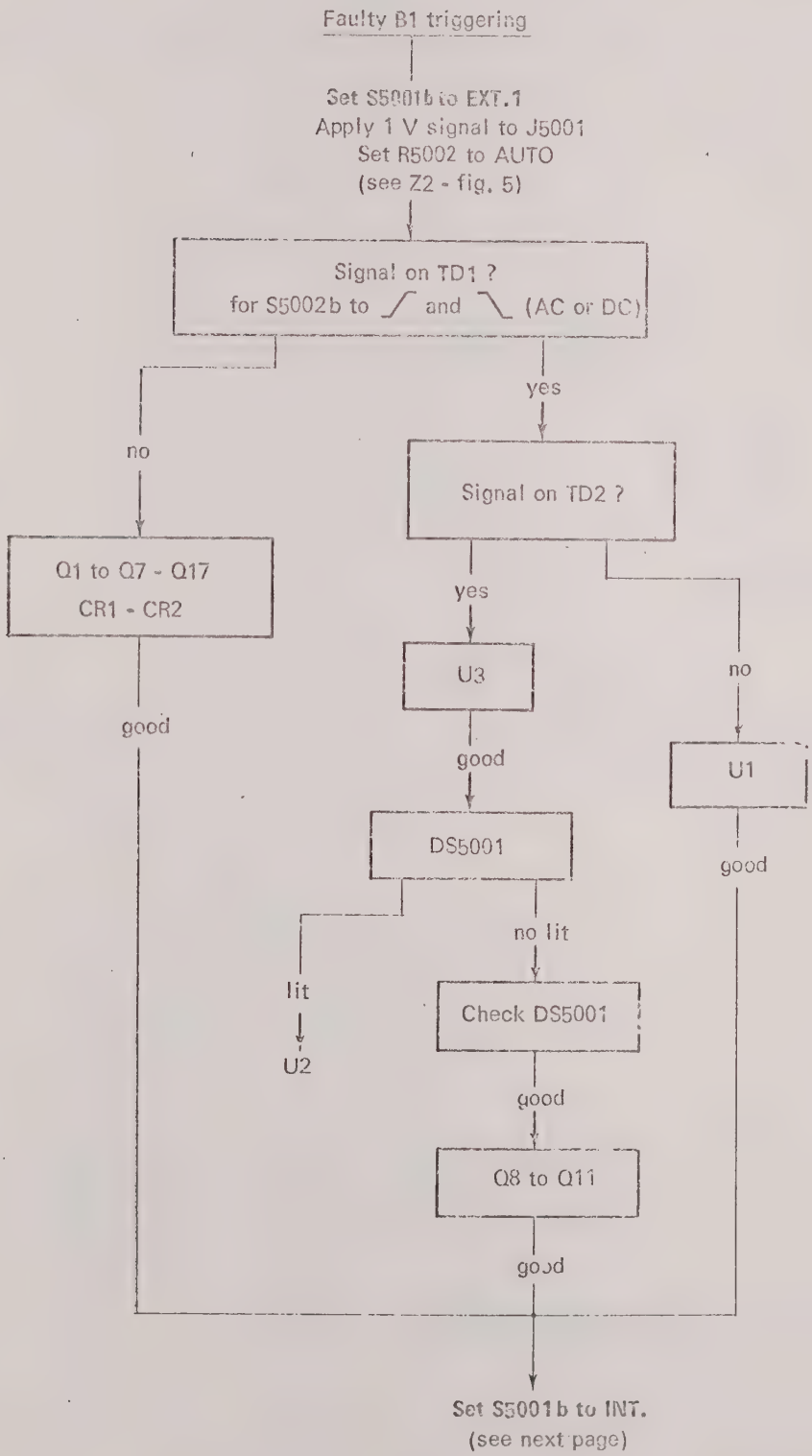
Check that the following are available on loop J202 :

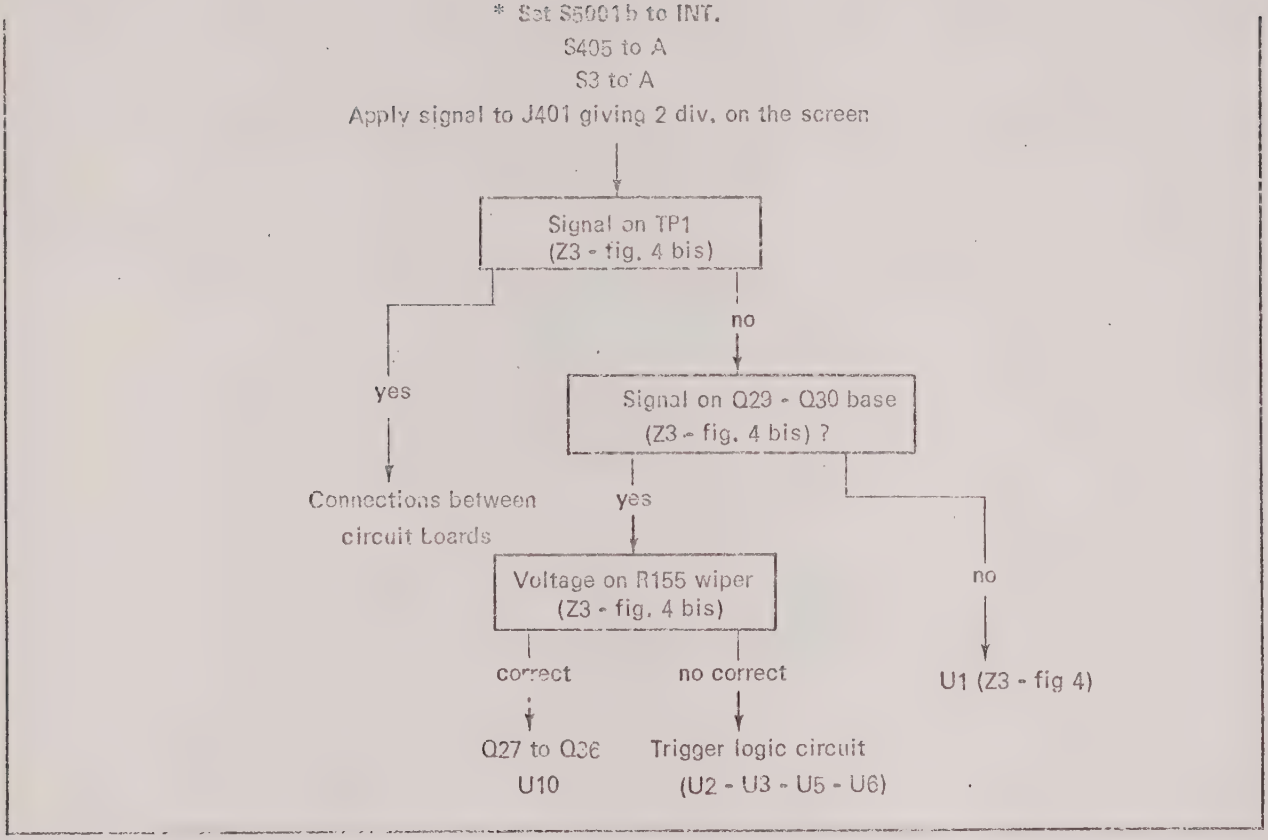
. a 20 mA ± 3% current squarewave
. a voltage squarewave of 600 mV ± 3 %

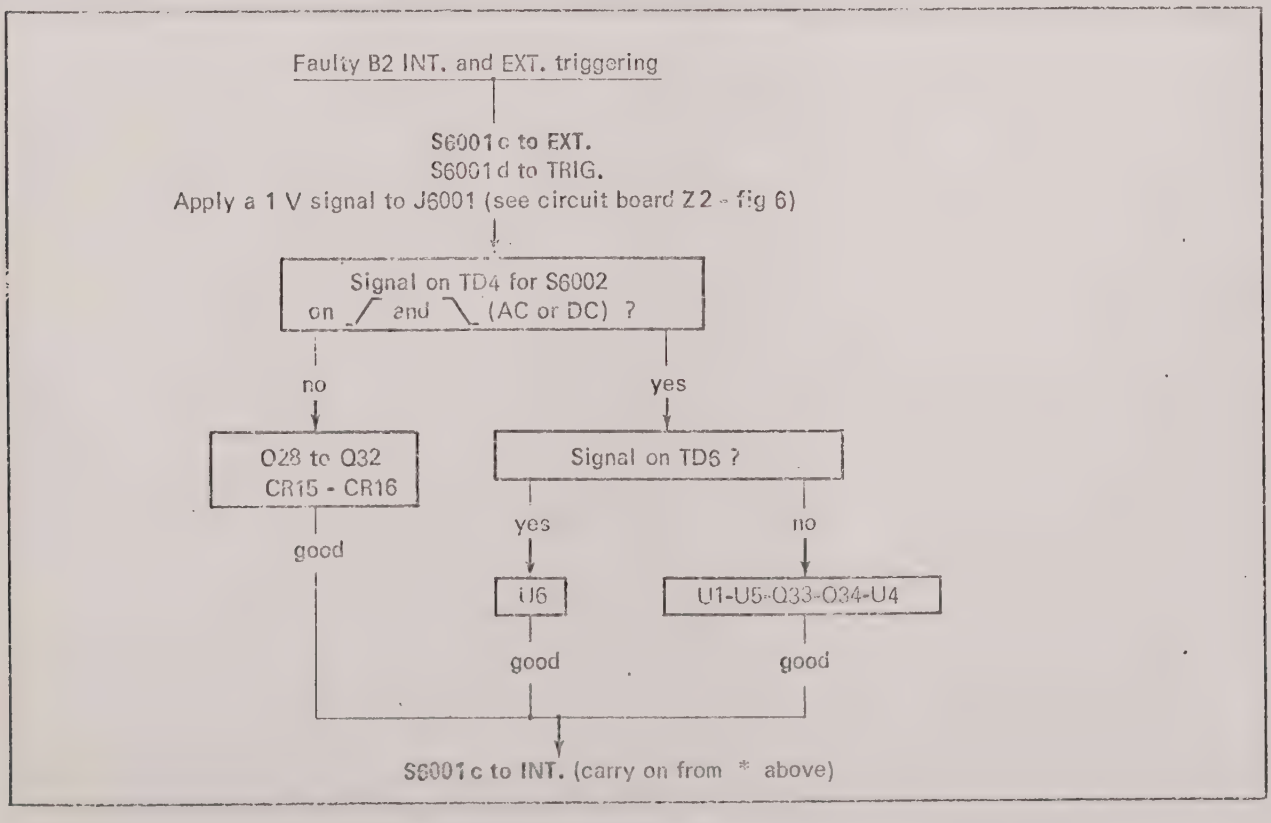
(See specification, page 9).

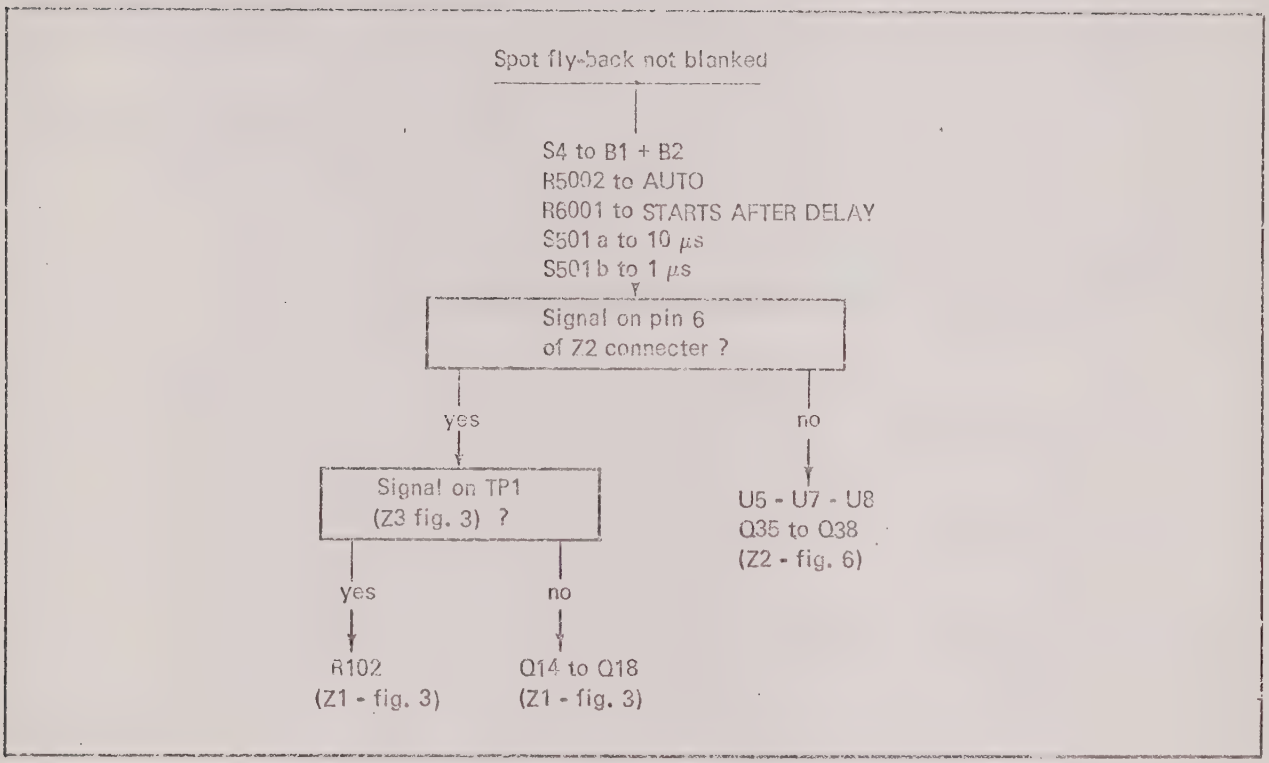

Spot on screen - no B1 sweep
Set S4 to B1 - R5002 to AUTO
Signal present on TP4 (Z2 - fig.5)
no
yes
Check Q24
no
X amplifier (Z2 - fig. 7)
Check with S4 d in SINGLE SWEEP position
Check Miller amplifier Q25
no
Check the various DC voltages marked on fig. 5 and replace the faulty component


B2 not working (B1 works)
Set S4 to B2 - S601 d to STARTS AFTER DELAY
Signal on TD5 ?
yes
no
Check Q46
good
Delay circuit U4 - Q33 - Q34
Miller amplifier Q45
good
Check the various DC voltages marked on fig. 6 and replace the faulty component


Faulty B1 triggering
Set S5001b to EXT.1
Apply 1 V signal to J5001
Set R5002 to AUTO
(see Z2 - fig. 5)
Signal on TD1 ?
for S5002b to ⌒ and ⌒ (AC or DC)
yes
no
Signal on TD2 ?
Q1 to Q7 - Q17
CR1 - CR2
yes
U3
no
good
good
U1
DS5001
good
no lit
lit
Check DS5001
U2
good
Q8 to Q11
good
Set S5001b to INT.
(see next page)


* Set S5001b to INT.
S405 to A
S3 to A
Apply signal to J401 giving 2 div. on the screen
Signal on TP1
(Z3 - fig. 4 bis)
yes
no
Signal on Q23 - Q30 base
(Z3 - fig. 4 bis) ?
Connections between
circuit boards
yes
no
Voltage on R155 wiper
(Z3 - fig. 4 bis)
correct
no correct
U1 (Z3 - fig 4)
Q27 to Q36
U10
Trigger logic circuit
(U2 - U3 - U5 - U6)


Faulty B2 INT. and EXT. triggering
S6001c to EXT.
S6001d to TRIG.
Apply a 1 V signal to J6001 (see circuit board Z2 - fig 6)
Signal on TD4 for S6002
on ⟋ and ⟍ (AC or DC) ?
no
yes
Q28 to Q32
CR15 - CR16
Signal on TD6 ?
good
yes
no
U6
U1-U5-Q33-Q34-U4
good
good
S6001c to INT. (carry on from * above)


Spot fly-back not blanked
S4 to B1 + B2
R5002 to AUTO
R6001 to STARTS AFTER DELAY
S501 a to 10 µs
S501 b to 1 µs
Signal on pin 6 of Z2 connecter ?
yes
no
Signal on TP1 (Z3 fig. 3) ?
U5 - U7 - U8 Q35 to Q38 (Z2 - fig. 6)
yes
no
R102 (Z1 - fig. 3)
Q14 to Q18 (Z1 - fig. 3)

4.5. - SETTING UP

The operations are described in the logical and functional order in which they should be carried out.

4.5.1. - Low voltage power supplies (Z1 - fig. 2 - plate P2)

- Using the digital multimeter, set the + 14 V line with potentiometer R11.
- Check that the - 5.2 V and + 50 V lines regulate correctly with the line input at ± 10%
- Check the non-regulated + 140 V and + 20 V lines.

4.5.2. - HT power supply (Z1 - fig. 3 - plate P2)

- Set the cathode voltage of the CRT to - 1475 V with R34, using the 2000 V electrostatic voltmeter.
- Adjust R58 to set the voltage at the junction of R58 and R59 to + 675 V.
- Align the trace with the graticule with the trace rotation potentiometer R111.

4.5.3. - Cathode ray tube (Z1 - fig. 2 and 3 - plate P2)

- Set the focus voltage to 200 V with respect to the cathode using the FOCUS control R108 (front panel - P1). Do not readjust R108 while carrying out the following adjustments.
- Set the controls in the following positions :
  - . S4 to B1
  - . R5002 to AUTO
  - . B1 TIME/DIV. S501 to 0.2 ms/div.
- Ground the input of the Y channel in use by selecting 0 with the input coupling selector.

- Turn BRILLIANCE control R75 (front panel - P1) until a trace of adequate intensity is displayed on the screen.
- Shift the trace to the middle of the screen in the Y direction and adjust the X shift so that it sweeps the whole screen width.
- Adjust ASTIGMATISM control R66 (front panel) for the finest possible trace without touching FOCUS R108 (front panel - P1), then adjust TRACE ROTATE R111 (fig. 3) until the trace coincides with the horizontal scale line in the centre of the screen.

Horizontal geometry (Vj2x voltage - CRT pin 8)

- Shift the trace up to the top horizontal scale line and adjust Vj2x with potentiometer R59 (fig. 3) so that the trace is parallel with this line (correction of cushion or barrel distortion).
- Shift the trace down to the bottom horizontal line on the screen and check that it is parallel with this line.
- Readjust Vj2x slightly with potentiometer R59 if necessary to obtain minimum distortion.

Action of Vj2x

Focus (Vj1x voltage - CRT pin 4)

- Apply a sinewave at about 10 kHz to one of the Y inputs.
- Stop the sweep by turning S501 fully anticlockwise to the XY position, and adjust the amplitude of the sinewave input until the trace sweeps the whole height of the screen.

- Now shift this vertical trace with the X shift controls to the centre of the screen. Focus it as well as possible by adjusting the Vj1x voltage with potentiometer R103.

Vertical geometry (Vj2y voltage - CRT pin 11)

- Shift the trace until it coincides with the vertical left-hand scale line. Adjust the Vj2y voltage with potentiometer R104 so that the trace is parallel with the line (correction of cushion or barrel distortion). Then shift the trace to the right-hand vertical scale line and check that it is also parallel with this line.
- It may be necessary to readjust Vj2y slightly with R104 to obtain the best geometry. Geometry adjustment with Vj2y slightly modifies the geometry obtained with Vj2x. To obtain the best result, carry out successive readjustments of the Vj2x and Vj2y settings.

Action of Vj2y

S distortion (Vg5 voltage - CRT pin 2)

S distortion cannot be corrected by adjustment of Vj2y.

- correct the geometry by adjusting Vg5 with potentiometer R62.

Action of Vg5

- Select a B1 sweep rate with S501 so that about 30 cycles of sinewave are displayed on the screen ; and adjust the X and Y amplitude and shift controls so that this display covers the whole scale area. Adjust the brillance for fairly high trace intensity.
- Adjust the Vj1x voltage (pin 4) with R103 so that the vertical lines of the trace are as fine as possible.
- Adjust the sharpness of the peaks (voltage Vg4) with the ASTIGMATISM control R66 on the front panel. Repeat these two adjustments until the whole trace is as fine as possible.

Deflection linearity check

- Reduce the amplitude of the image displayed to 1 division using the Y attenuator and the generator level control.
- Shift this image vertically and check that its amplitude remains constant over the whole scale area.
- If the linearity is not satisfactory the potential difference between Vj2x and Vj2y must be changed and the X and Y geometry adjustments redone.

4.5.4. - X amplifier (Z2 - fig. 7 - P3)

. push-button switch S3 to B1

. TIME/DIV. selector S501 a to 1 ms

. B1 TRIGGER LEVEL control R5002 to AUTO

- Adjust the sweep length to 11 divisions with R266.
- Shift the trace off to either side of the screen and centre this action with R273.
- Turn X SHIFT controls R295 a and b to mid-travel and select XY with S501 a and EXT. 1 with S601.
- Bring the spot to the centre of the screen with R254.

COMPTEURS

Schlumberger

Référence 5212

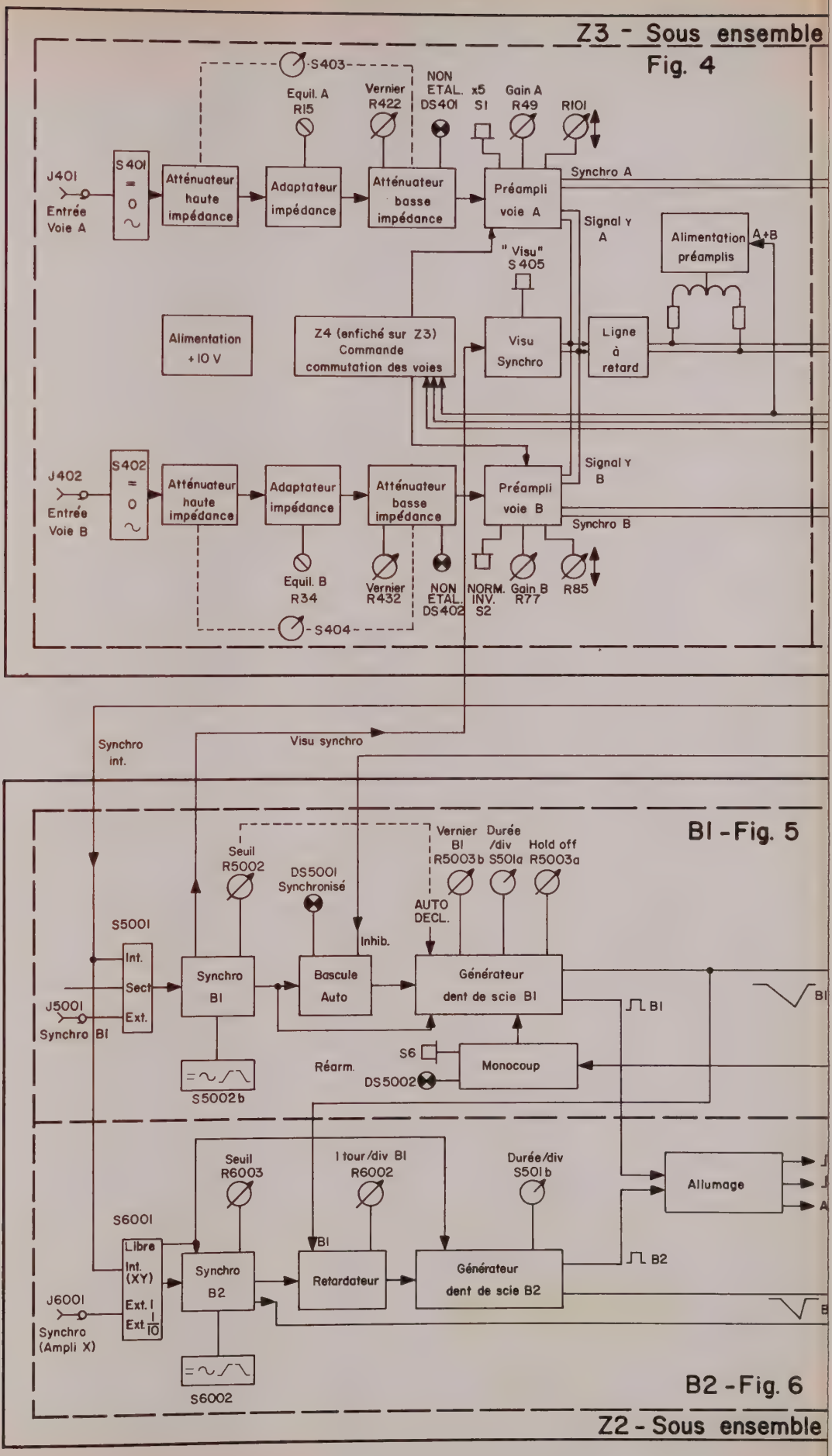
Date

Dessiné par

Commandes exécutées

Cde nº

App. nº


Z3 - Sous ensemble
Fig. 4
S403
Equil. A R15
Vernier R422
NON ETAL. DS401
x5 S1
Gain A R49
R101
J401
Entrée Voie A
S401
Atténuateur haute impédance
Adaptateur impédance
Atténuateur basse impédance
Préampli voie A
Synchro A
Signal Y A
Alimentation préamplis
A+B
" Visu" S405
Alimentation +10 V
Z4 (enfiché sur Z3) Commande commutation des voies
Visu Synchro
Ligne à retard
J402
Entrée Voie B
S402
Atténuateur haute impédance
Adaptateur impédance
Atténuateur basse impédance
Préampli voie B
Signal Y B
Synchro B
Equil. B R34
Vernier R432
NON ETAL. DS402
NORM. INV. S2
Gain B R77
R85
S404
Synchro int.
Visu synchro
B1 - Fig. 5
Seuil R5002
DS5001 Synchronisé
Vernier B1 R5003b
Durée /div S501a
Hold off R5003a
AUTO DECL.
Inhib.
S5001
Int.
Sect
Ext.
J5001
Synchro B1
Synchro B1
Bascule Auto
Générateur dent de scie B1
B1
S6
Réarm.
DS5002
Monocoup
S5002b
Seuil R6003
1 tour/div B1 R6002
Durée/div S501b
Allumage
S6001
Libre
Int. (XY)
Ext. 1
Ext. 10
J6001
Synchro (Ampli X)
Synchro B2
B1
Retardateur
Générateur dent de scie B2
B2
S6002
B2 - Fig. 6
Z2 - Sous ensemble

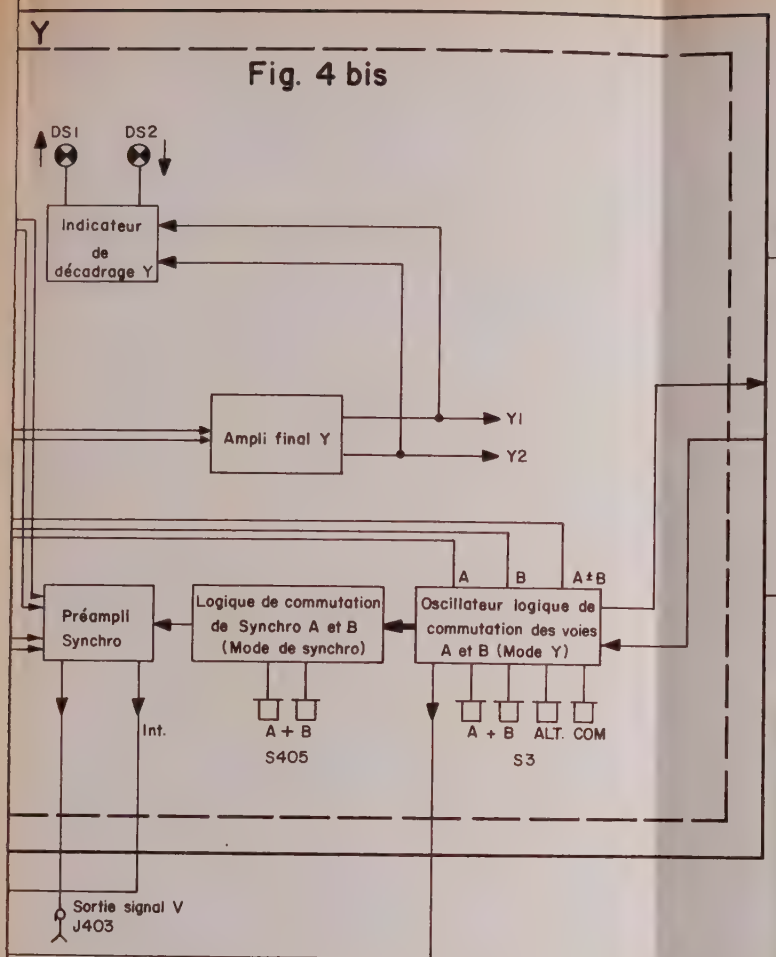
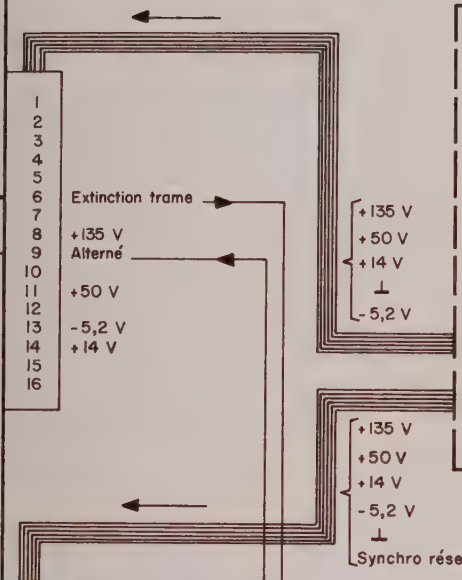

Y
DS1
DS2
Indicateur de décadrage Y
Ampli final Y
Y1
Y2
Préampli Synchro
Logique de commutation de Synchro A et B (Mode de synchro)
Oscillateur logique de commutation des voies A et B (Mode Y)
A
B
A±B
Int.
A + B
S405
A + B
ALT.
COM
S3
Sortie signal V
J403

Fig. 4 bis


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Extinction trame
+135 V
Alterné
+50 V
-5,2 V
+14 V
+135 V
+50 V
+14 V
⊥
-5,2 V
+135 V
+50 V
+14 V
-5,2 V
⊥
Synchro réseau

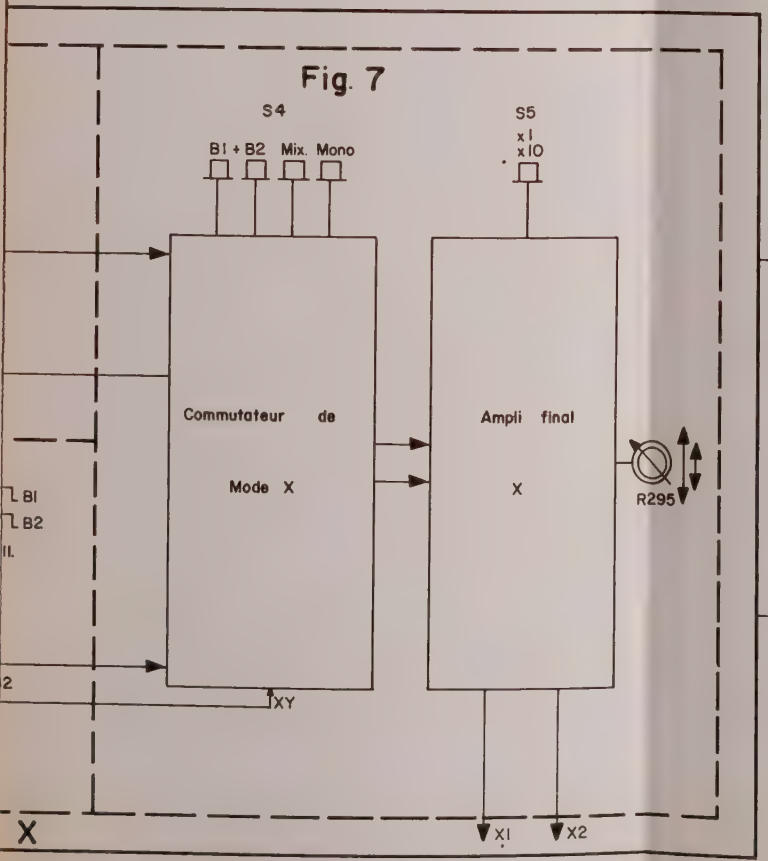
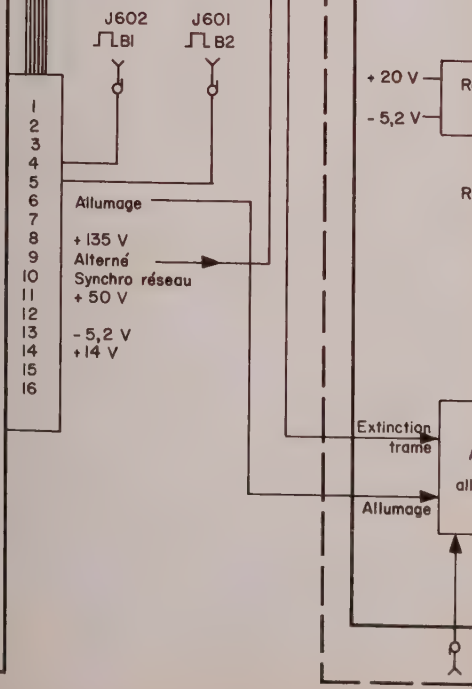


Fig. 7
S4
B1 + B2
Mix.
Mono
S5
x1
x10
Commutateur de Mode X
Ampli final X
R295
B1
B2
XY
X
X1
X2


J602
B1
J601
B2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Allumage
+135 V
Alterné
Synchro réseau
+50 V
-5,2 V
+14 V
+20 V
-5,2 V
Extinction trame
Allumage
MODE
J301

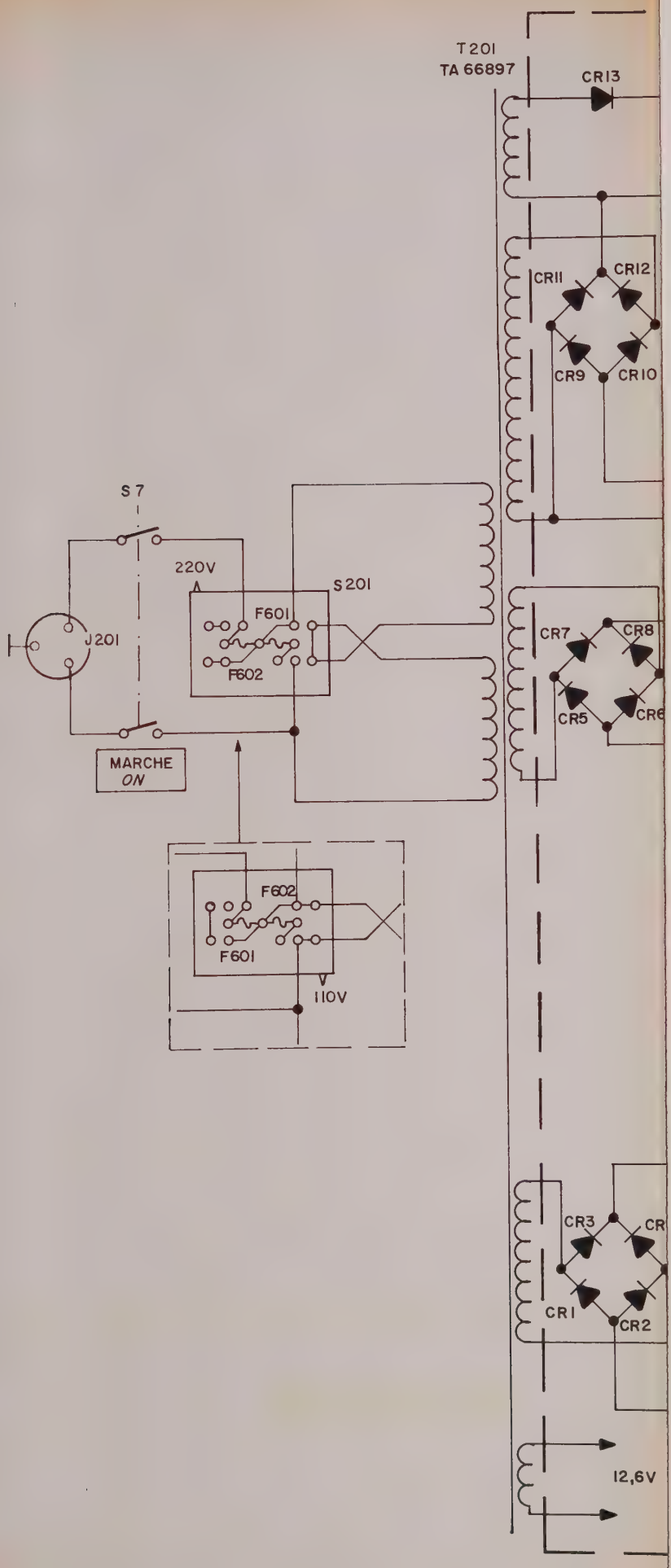
Schlumberger

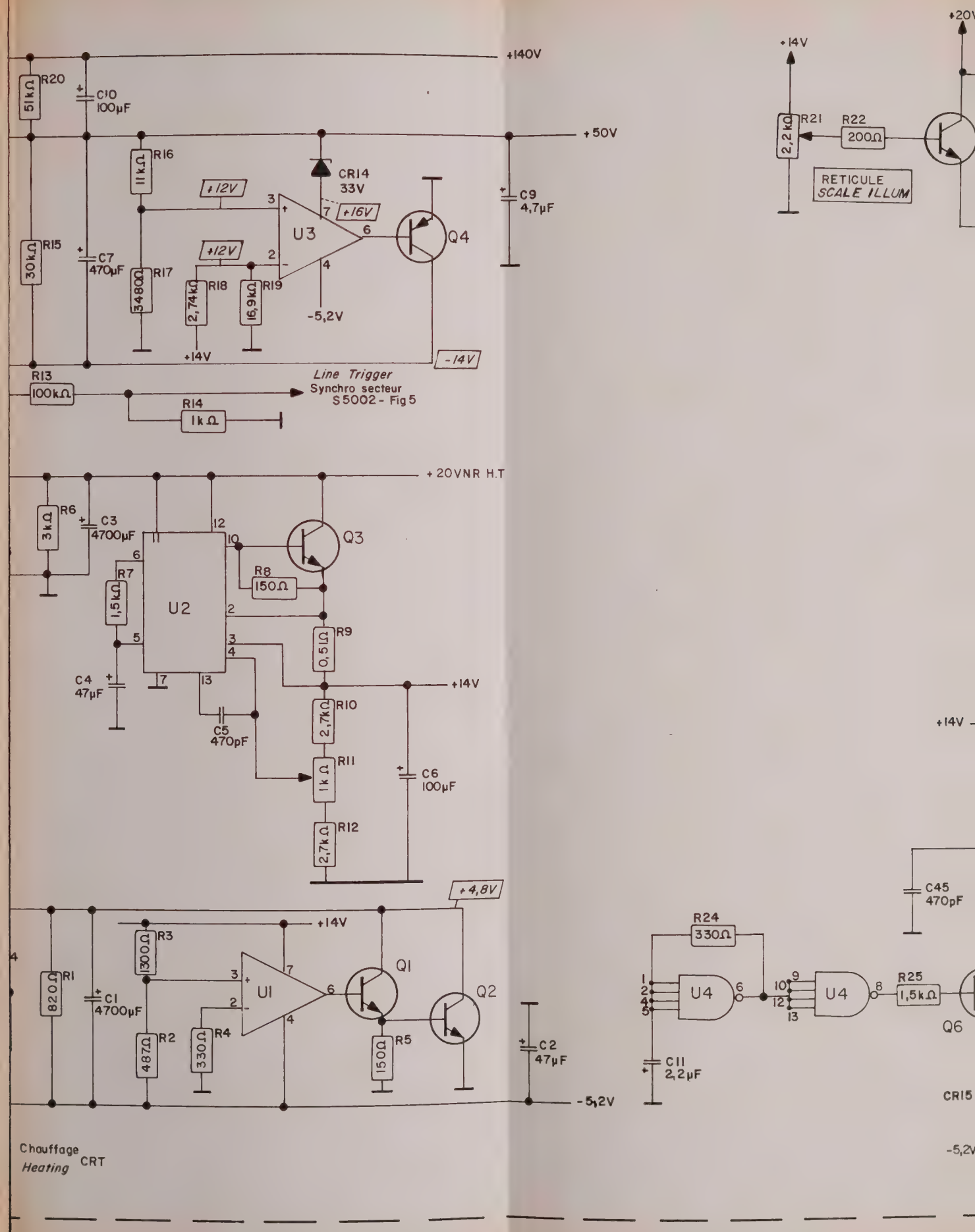
Référence 5212

Date le 4 Aout 75 | Dessiné par Jean Bourg

Commandes exécutées

Cde nº | App. nº

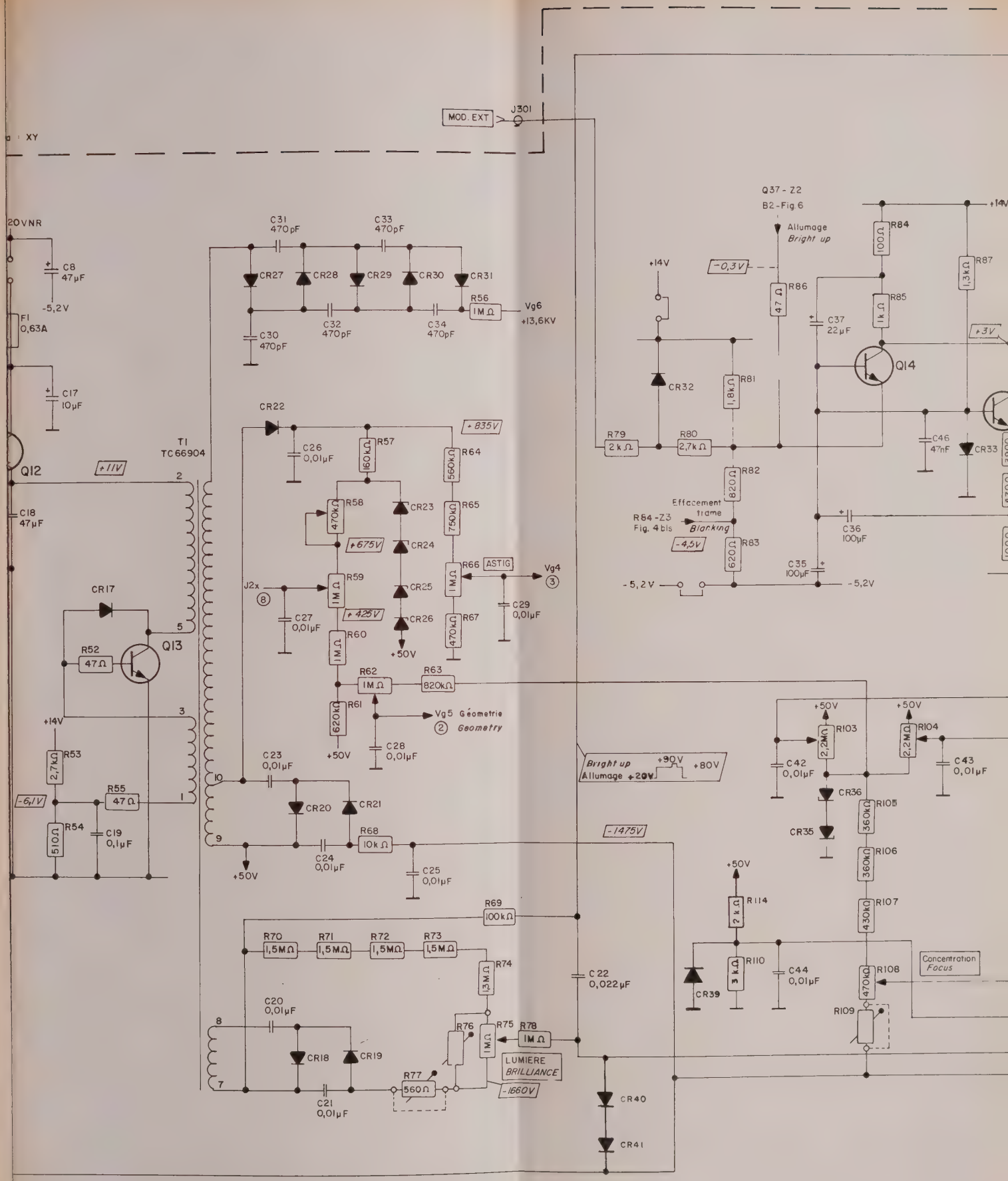

T201
TA 66897
CR13
CR11
CR12
CR9
CR10
S7
220V
S201
F601
J201
F602
CR7
CR8
CR5
CR6
MARCHE
ON
F602
F601
110V
CR3
CR
CR1
CR2
12,6V

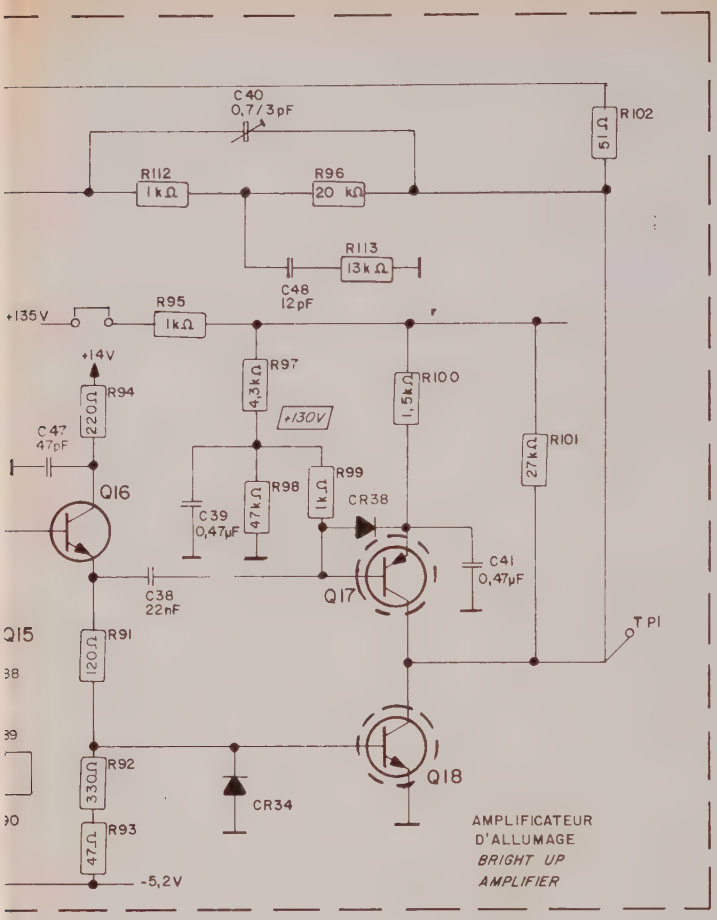

+140V
R20
51kΩ
C10
100µF
+50V
R16
11kΩ
CR14
33V
+12V
+16V
U3
C9
4,7µF
Q4
R15
30kΩ
C7
470µF
R17
3480Ω
R18
2,74kΩ
R19
16,9kΩ
-5,2V
+14V
-14V
R13
100kΩ
Line Trigger
Synchro secteur
S5002 - Fig 5
R14
1kΩ
+14V
R21
2,2kΩ
R22
200Ω
RETICULE
SCALE ILLUM
+20V
+20VNR H.T
R6
3kΩ
C3
4700µF
Q3
R7
1,5kΩ
U2
R8
150Ω
R9
0,5Ω
C4
47µF
C5
470pF
+14V
R10
2,7kΩ
R11
1kΩ
C6
100µF
R12
2,7kΩ
+4,8V
+14V
R3
300Ω
R1
820Ω
C1
4700µF
U1
Q1
Q2
R2
487Ω
R4
330Ω
R5
150Ω
C2
47µF
-5,2V
C45
470pF
R24
330Ω
U4
U4
R25
1,5kΩ
Q6
C11
2,2µF
CR15
-5,2V
Chauffage
Heating
CRT

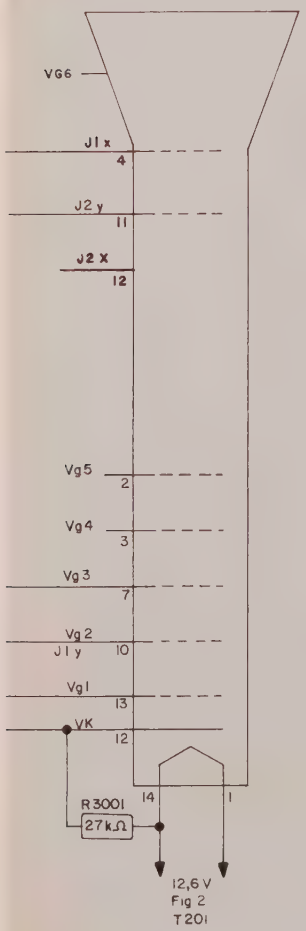
ALIMENTATION BASSE TENSION
POWER SUPPLY

5212 4612

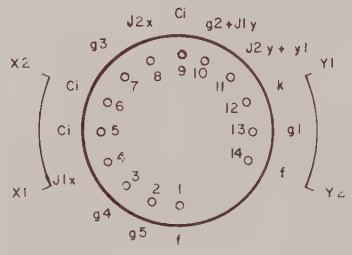
Fig2


MOD. EXT
J301
XY
220VNR
C8 47µF
-5,2V
F1 0,63A
C17 10µF
Q12
+11V
T1 TC66904
C18 47µF
C31 470pF
C33 470pF
CR27
CR28
CR29
CR30
CR31
R56 1MΩ
Vg6 +13,6KV
C30 470pF
C32 470pF
C34 470pF
CR22
+835V
C26 0,01µF
160kΩ R57
560kΩ R64
470kΩ R58
CR23
750kΩ R65
+675V
CR24
CR17
R52 47Ω
Q13
J2x
1MΩ R59
ASTIG
Vg4
C27 0,01µF
+425V
1MΩ R60
CR25
CR26
+50V
C29 0,01µF
470kΩ R67
R62 1MΩ
R63 820kΩ
620kΩ R61
Vg5 Géometrie
Geometry
C28 0,01µF
+14V
2,7kΩ R53
R55 47Ω
-6,1V
510Ω R54
C19 0,1µF
C23 0,01µF
CR20
CR21
R68 10kΩ
C24 0,01µF
C25 0,01µF
-1475V
R69 100kΩ
R70 1,5MΩ
R71 1,5MΩ
R72 1,5MΩ
R73 1,5MΩ
R74 3MΩ
C22 0,022µF
C20 0,01µF
R76
R75 1MΩ
R78 1MΩ
CR18
CR19
R77 560Ω
LUMIERE BRILLIANCE
-1660V
C21 0,01µF
CR40
CR41
Q37 - Z2
B2 - Fig. 6
Allumage Bright up
+14V
-0,3V
100Ω R84
1,3kΩ R87
47Ω R86
1kΩ R85
C37 22µF
+3V
Q14
CR32
1,8kΩ R81
R79 2kΩ
R80 2,7kΩ
820Ω R82
Effacement trame
R84 - Z3 Fig. 4 bis
Blanking
-4,5V
620Ω R83
C46 47nF
CR33
C36 100µF
C35 100µF
-5,2V
Bright up Allumage +20V
+90V
+80V
+50V
2,2MΩ R103
2,2MΩ R104
C42 0,01µF
C43 0,01µF
CR36
CR35
360kΩ R105
360kΩ R106
430kΩ R107
2kΩ R114
3kΩ R110
C44 0,01µF
CR39
470kΩ R108
R109
Concentration Focus
Z1

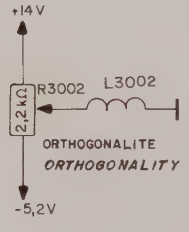




V3001
TUBE
CATHODIQUE
CRT



Brochage du culot du tube
CRT socket connection



HAUTE TENSION ALLUMAGE
E H T POWER SUPPLY BRIGHT-UP

5212 4613

Fig 3

Schlumberger

Référence 5212

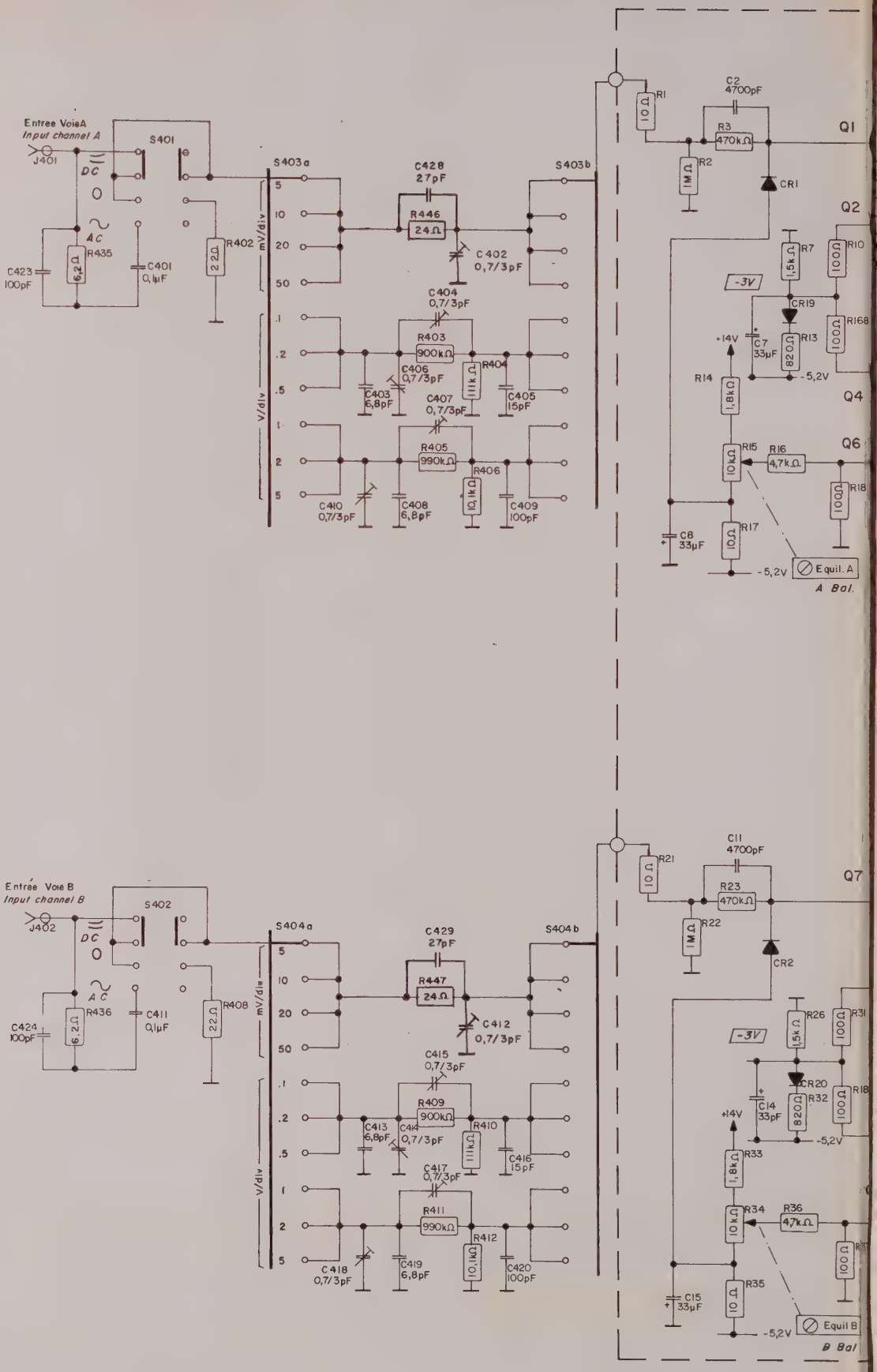
Date le 4 Avril 75

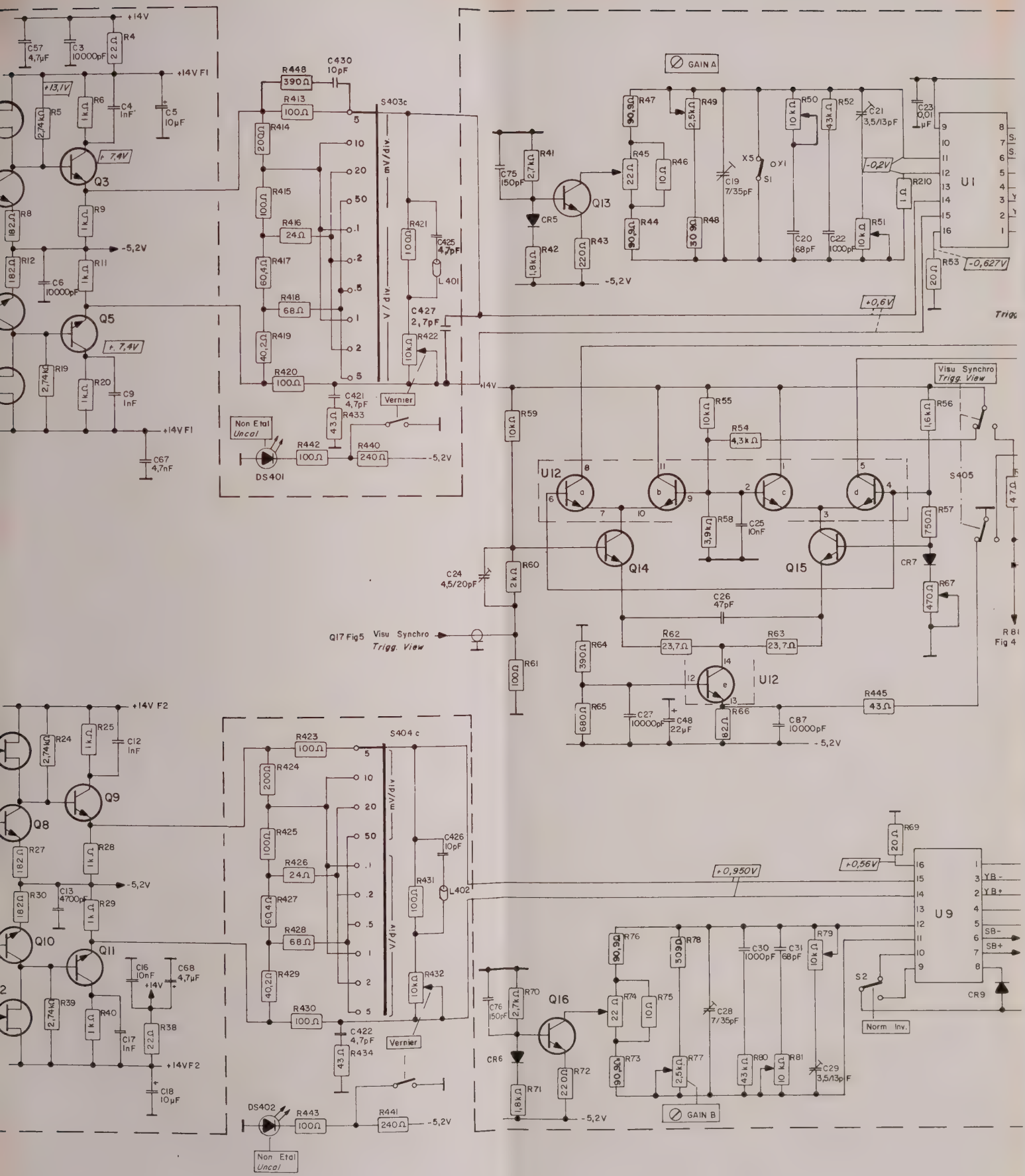
Dessiné par Mme Bonnefoy

Commandes exécutées

Cde n°

App. n°


Entree Voie A
Input channel A
J401
S401
DC
AC
R435
6,2Ω
C423
100pF
C401
0,1µF
R402
22Ω
S403a
S403b
mV/div
V/div
5
10
20
50
.1
.2
.5
1
2
5
C428
27pF
R446
24Ω
C402
0,7/3pF
C404
0,7/3pF
R403
900kΩ
C406
0,7/3pF
R404
111kΩ
C403
6,8pF
C407
0,7/3pF
C405
15pF
R405
990kΩ
R406
10,1kΩ
C410
0,7/3pF
C408
6,8pF
C409
100pF
R1
10Ω
C2
4700pF
R3
470kΩ
Q1
R2
1MΩ
CR1
Q2
R7
1,5kΩ
R10
100Ω
-3V
CR19
R168
100Ω
+14V
C7
33µF
R13
820Ω
-5,2V
R14
1,8kΩ
Q4
R15
10kΩ
R16
4,7kΩ
Q6
R18
100Ω
C8
33µF
R17
10Ω
-5,2V
Equil. A
A Bal.
Entrée Voie B
Input channel B
J402
S402
DC
AC
R436
6,2Ω
C424
100pF
C411
0,1µF
R408
22Ω
S404a
S404b
mV/div
V/div
C429
27pF
R447
24Ω
C412
0,7/3pF
C415
0,7/3pF
R409
900kΩ
C413
6,8pF
C414
0,7/3pF
R410
111kΩ
C416
15pF
C417
0,7/3pF
R411
990kΩ
R412
10,1kΩ
C418
0,7/3pF
C419
6,8pF
C420
100pF
C11
4700pF
R21
10Ω
R23
470kΩ
Q7
R22
1MΩ
CR2
R26
1,5kΩ
R31
100Ω
-3V
CR20
R18
100Ω
C14
33pF
R32
820Ω
+14V
-5,2V
R33
1,8kΩ
R34
10kΩ
R36
4,7kΩ
R35
10Ω
C15
33µF
-5,2V
Equil B
B Bal


+14V
+14V F1
+13,1V
+7,4V
-5,2V
+14V F2
+14V F2
S403c
S404 c
mV/div
V/div
Vernier
Non Etal
Uncal
DS401
DS402
GAIN A
GAIN B
U1
U9
U12
Q3
Q5
Q8
Q9
Q10
Q11
Q13
Q14
Q15
Q16
S405
S2
X5
X1
Norm Inv.
Visu Synchro
Trigg. View
Q17 Fig5
R 81
Fig 4
-0,2V
-0,627V
+0,6V
+0,950V
+0,56V
YB-
YB+
SB-
SB+

PREAMPLIFICATEURS A ET B
A AND B PREAMPLIFIERS

5212-4604

Fig 4

Schlumberger

Référence 5212

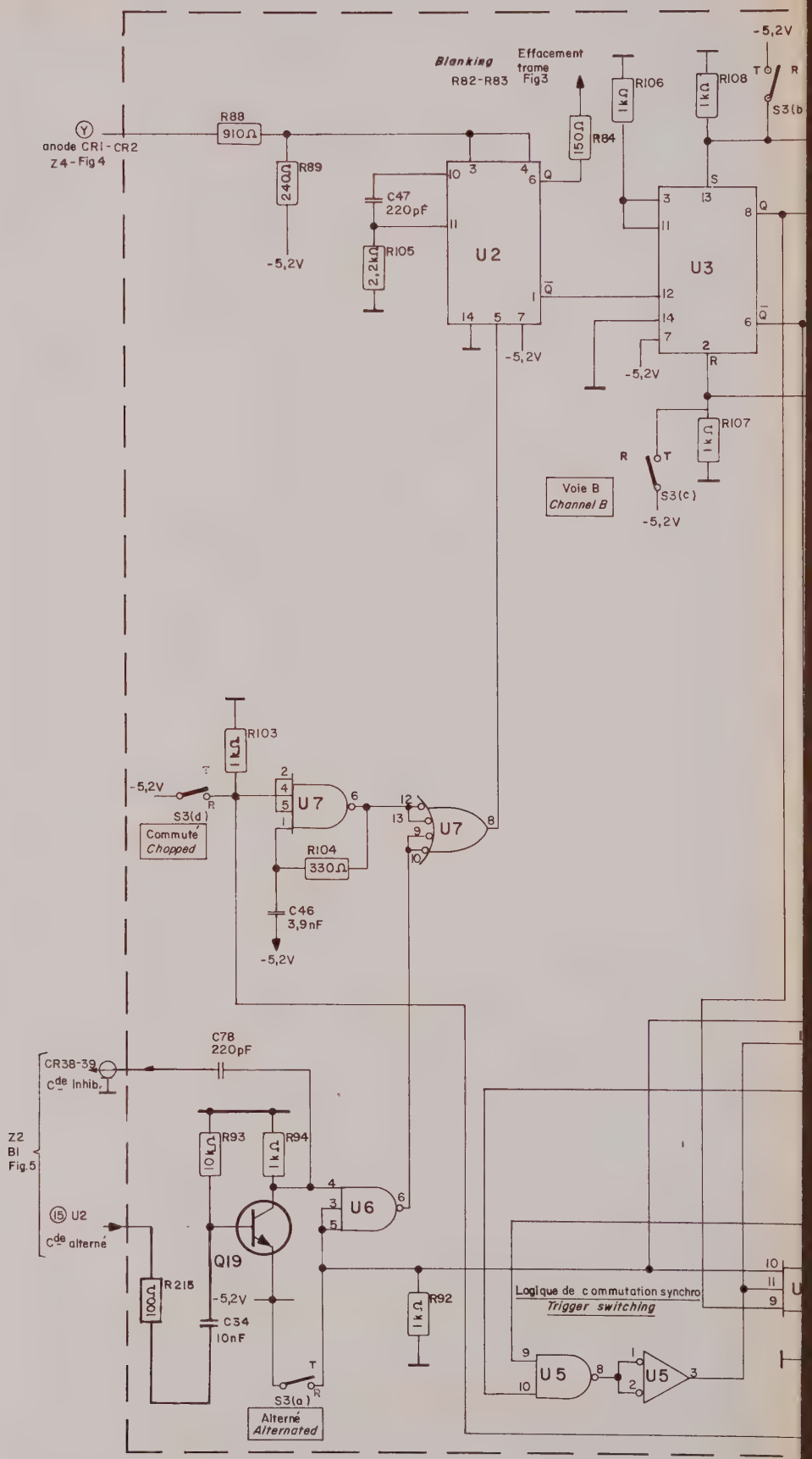
Date le 4 Août 75

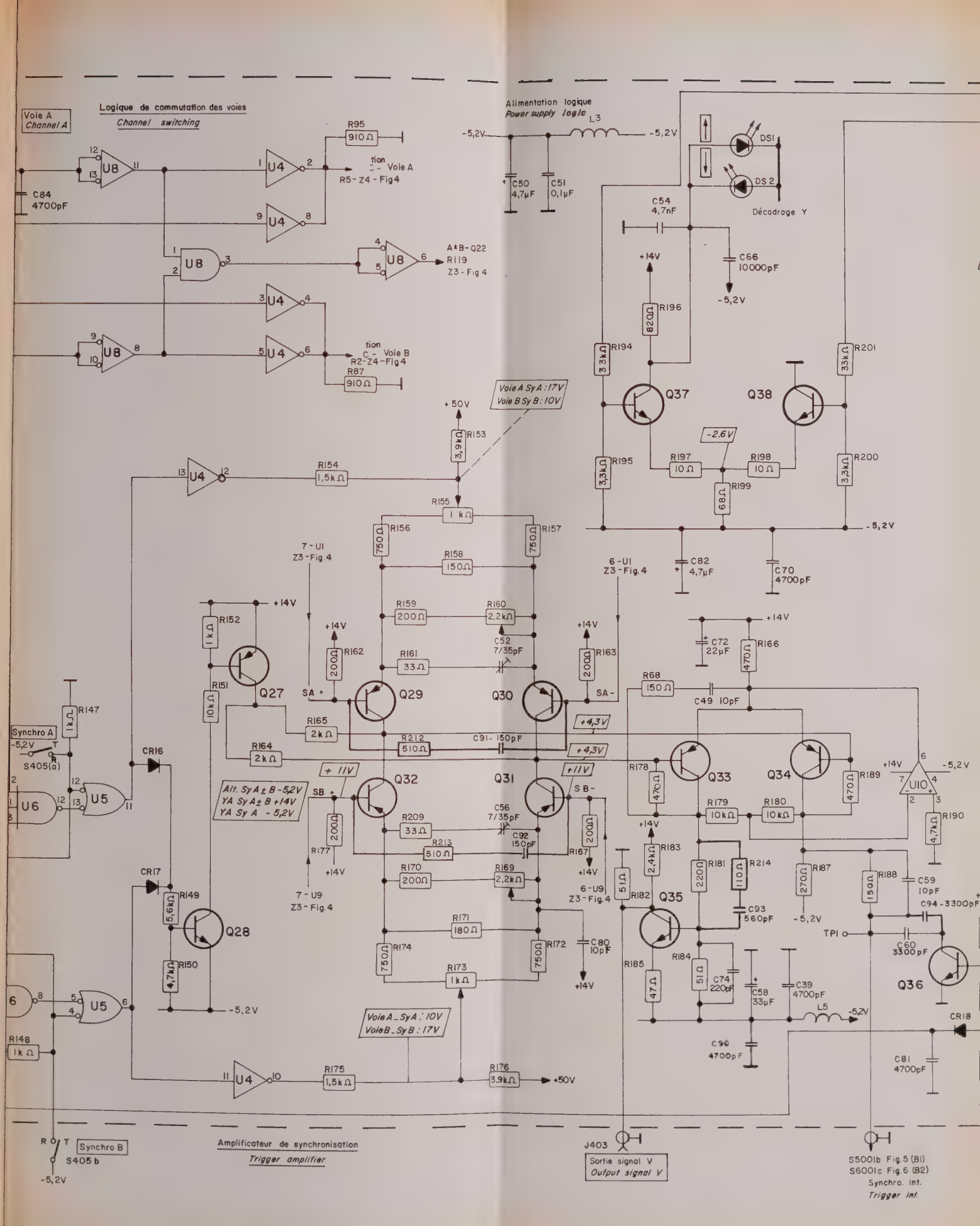
Dessiné par Mme Bo

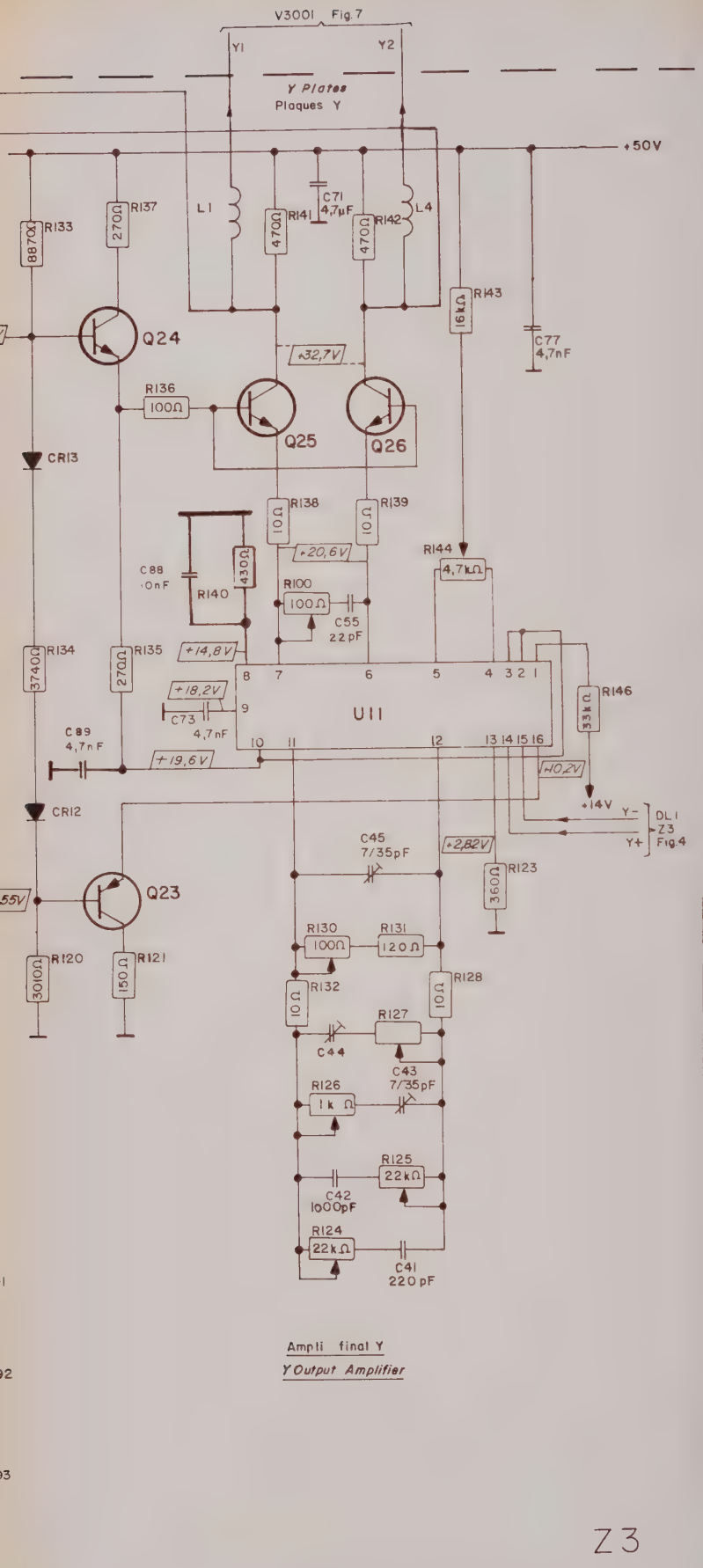
Commandes exécutées

Cde nº

App. nº


Blanking
Effacement trame Fig3
R82-R83
-5,2V
R106
1kΩ
R108
1kΩ
T
R
S3(b
R88
910Ω
R84
150Ω
anode CR1-CR2
Z4-Fig4
R89
240Ω
C47
220pF
R105
2,2kΩ
U2
U3
-5,2V
R107
1kΩ
Voie B
Channel B
S3(c)
R103
1kΩ
S3(d)
Commute
Chopped
U7
R104
330Ω
C46
3,9nF
C78
220pF
CR38-39
Cde inhib.
Z2
B1
Fig.5
R93
10kΩ
R94
1kΩ
U6
15 U2
Cde alterné
Q19
R215
100Ω
C34
10nF
R92
1kΩ
S3(a)
Alterné
Alternated
Logique de commutation synchro
Trigger switching
U5


Logique de commutation des voies
Channel switching
Voie A
Channel A
Alimentation logique
Power supply logic
L3
-5,2V
DS1
DS2
Décadrage Y
C54 4,7nF
C66 10000pF
C50 4,7µF
C51 0,1µF
C84 4700pF
R95 910Ω
tion C - Voie A R5-Z4-Fig4
A±B-Q22 R119 Z3-Fig 4
tion C - Voie B R2-Z4-Fig4
R87 910Ω
U8
U4
+14V
R196 820Ω
R194 3,3kΩ
R201 33kΩ
Q37
Q38
-2,6V
R195 3,3kΩ
R197 10Ω
R198 10Ω
R199 68Ω
R200 3,3kΩ
Voie A Sy A : 17V
Voie B Sy B : 10V
+50V
R153 3,9kΩ
R154 1,5kΩ
R155 1kΩ
R156 750Ω
R157 750Ω
R158 150Ω
7-UI Z3-Fig.4
6-UI Z3-Fig.4
C82 4,7µF
C70 4700pF
R159 200Ω
R160 2,2kΩ
C52 7/35pF
R161 33Ω
R162 200Ω
R163 200Ω
R152 1kΩ
R151 10kΩ
Q27
Q29
Q30
SA+
SA-
C72 22µF
R166 470Ω
R68 150Ω
C49 10pF
+4,3V
R165 2kΩ
R212 510Ω
C91-150pF
R164 2kΩ
R147 1kΩ
Synchro A
-5,2V
S405(a)
CR16
+11V
Q32
Q31
SB+
SB-
Alt. Sy A ± B -5,2V
YA Sy A ± B +14V
YA Sy A -5,2V
R209 33Ω
C56 7/35pF
C92 150pF
R213 510Ω
R177 200Ω
R167 200Ω
R170 200Ω
R169 2,2kΩ
7-U9 Z3-Fig.4
6-U9 Z3-Fig.4
CR17
R149 5,6kΩ
Q28
R150 4,7kΩ
R171 180Ω
R174 750Ω
R172 750Ω
C80 10pF
R173 1kΩ
R148 1kΩ
Voie A_Sy A : 10V
Voie B_Sy B : 17V
R175 1,5kΩ
R176 3,9kΩ
+50V
R178 470Ω
Q33
Q34
R189 470Ω
R179 10kΩ
R180 10kΩ
U10
R190 4,7kΩ
R183 2,4kΩ
R181 220Ω
R214 110Ω
R182 51Ω
Q35
R187 270Ω
R188 150Ω
C59 10pF
C94-3300pF
TP1
C60 3300pF
Q36
R184 51Ω
C74 220pF
C58 33µF
C39 4700pF
L5
R185 47Ω
C96 4700pF
CR18
C81 4700pF
Synchro B
S405b
Amplificateur de synchronisation
Trigger amplifier
J403
Sortie signal V
Output signal V
S500 1b Fig.5 (B1)
S600 1c Fig.6 (B2)
Synchro. int.
Trigger int.



Ampli final Y

Y Output Amplifier

Fig4bis **LOGIQUE COMMUTATION, AMPLI SYNCHRO, AMPLI FINAL Y** 5212 4604

SWITCHING LOGIC; TRIGGER AMP., OUTPUT AMP. Y

Schlumberger

Référence 5212

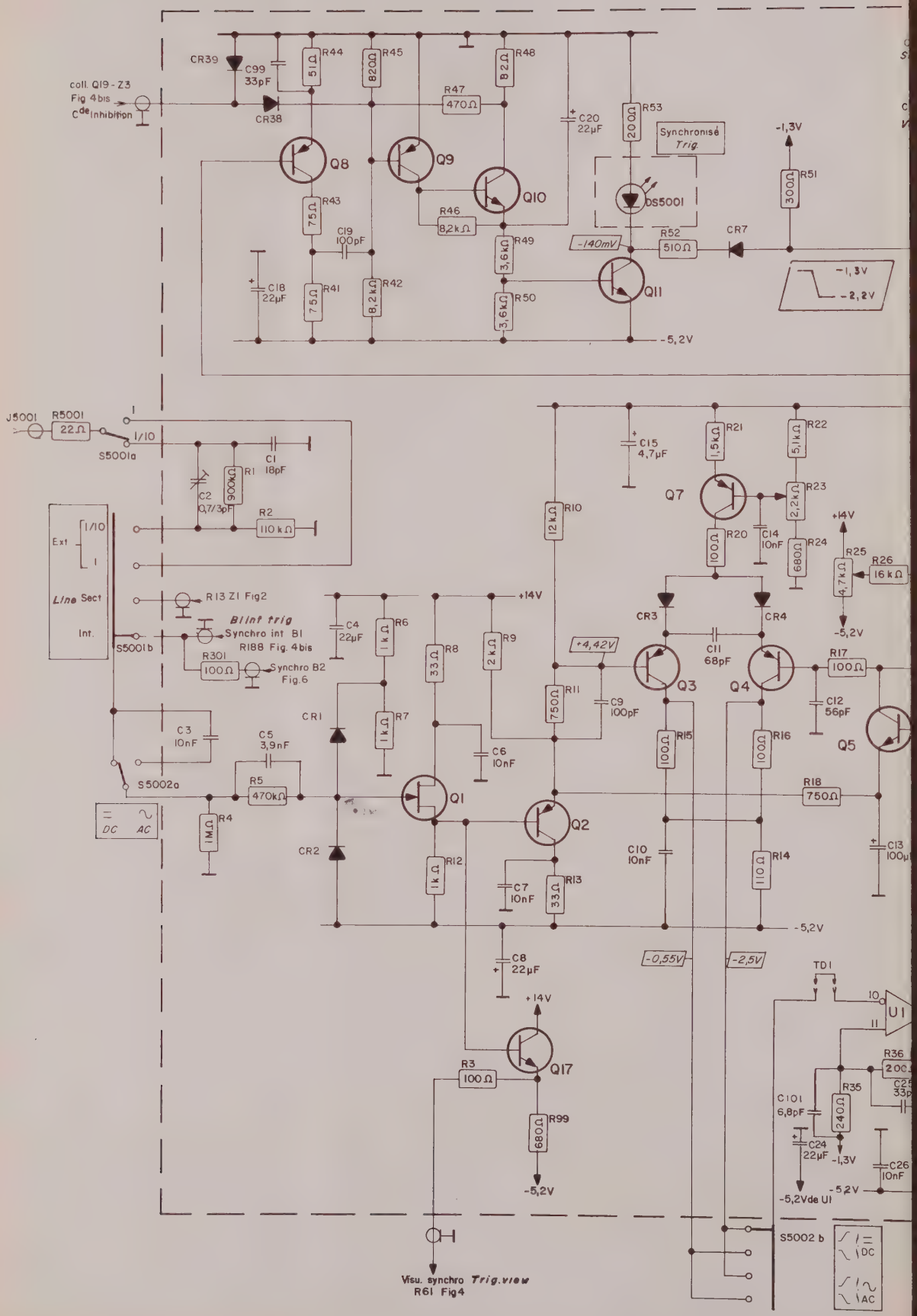
Date le 4 Août 75

Dessiné par [illegible]

Commandes exécutées

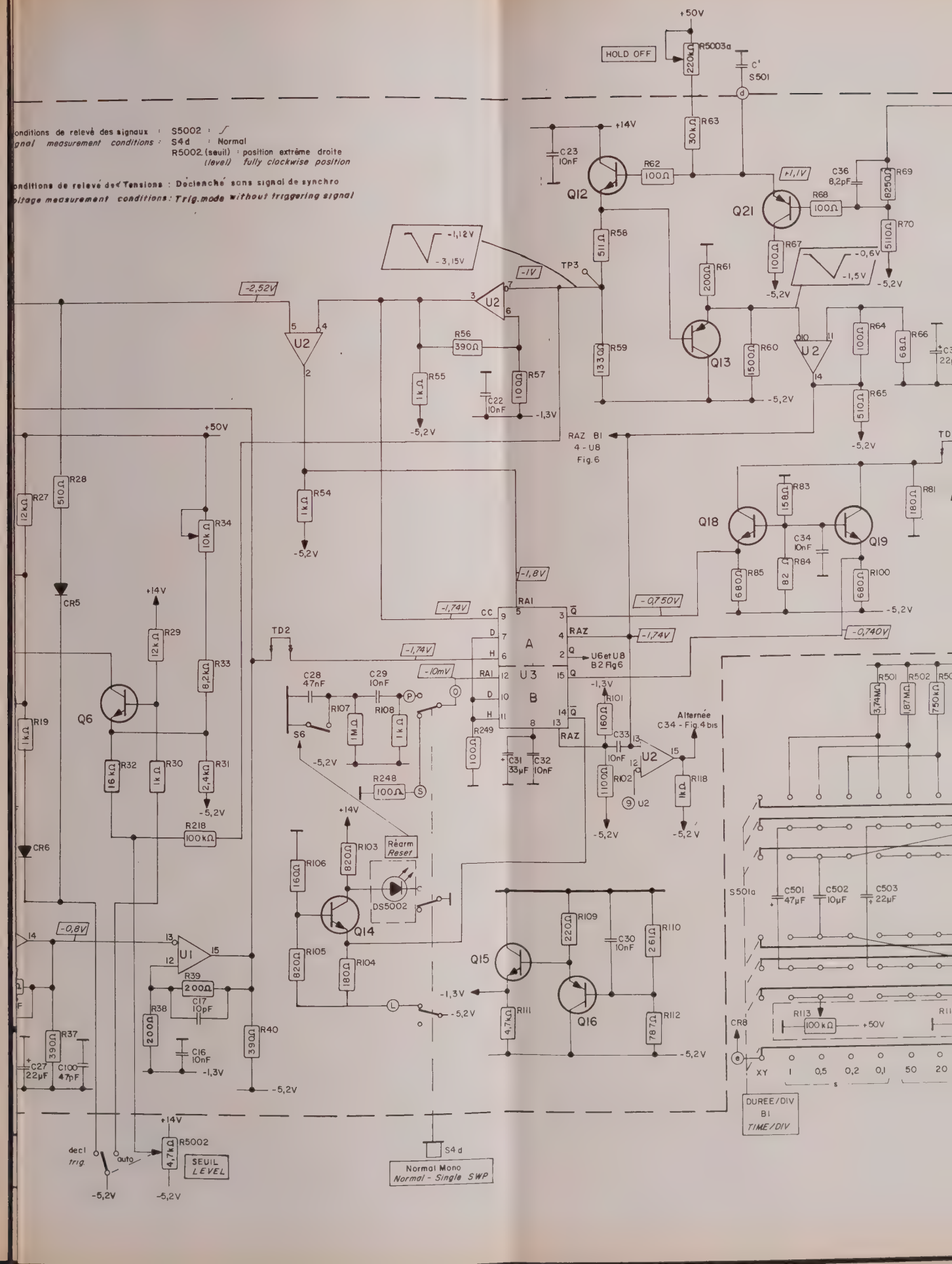
Cde nº

App. nº


coll. Q19 - Z3
Fig 4bis
Cde Inhibition
CR39
C99 33pF
CR38
R44 51Ω
R45 820Ω
R47 470Ω
R48 8,2Ω
C20 22µF
R53 200Ω
Synchronisé Trig.
DS5001
-1,3V
R51 300Ω
Q8
Q9
Q10
Q11
R43 75Ω
C19 100pF
R46 8,2kΩ
R49 3,6kΩ
R50 3,6kΩ
-140mV
R52 510Ω
CR7
-1,3V
-2,2V
C18 22µF
R41 75Ω
R42 8,2kΩ
-5,2V
J5001
R5001 22Ω
S5001a
1/10
1
C1 18pF
R1 900kΩ
C2 0,7/3pF
R2 110kΩ
Ext
Line Sect
Int.
S5001b
R13 Z1 Fig2
Blint trig
Synchro int B1
R188 Fig. 4bis
R301 100Ω
Synchro B2
Fig.6
C3 10nF
C5 3,9nF
S5002a
R5 470kΩ
R4 1MΩ
DC
AC
C4 22µF
R6 1kΩ
R7 1kΩ
CR1
CR2
R8 33Ω
R9 2kΩ
+14V
C6 10nF
R12 1kΩ
C7 10nF
R13 33Ω
Q1
Q2
C8 22µF
+14V
Q17
R3 100Ω
R99 680Ω
-5,2V
C15 4,7µF
R10 12kΩ
R11 750Ω
C9 100pF
+4,42V
CR3
CR4
C11 68pF
Q3
Q4
R21 1,5kΩ
R22 5,1kΩ
Q7
R23 2,2kΩ
R20 100Ω
C14 10nF
R24 680Ω
+14V
R25 4,7kΩ
R26 16kΩ
-5,2V
R17 100Ω
C12 56pF
Q5
R15 100Ω
R16 100Ω
R18 750Ω
C13 100µ
C10 10nF
R14 110Ω
-0,55V
-2,5V
-5,2V
TD1
U1
10
11
R36 200
C25 33p
R35 240Ω
C101 6,8pF
C24 22µF
-1,3V
C26 10nF
-5,2V
-5,2V de U1
S5002 b
DC
AC
Visu. synchro Trig.view
R61 Fig4

onditions de relevé des signaux : S5002 : ✓
gnal measurement conditions : S4d : Normal
R5002 (seuil) : position extrême droite
(level) fully clockwise position

onditions de relevé des Tensions : Déclenché sans signal de synchro
oltage measurement conditions : Trig.mode without triggering signal



SYNCHRO BI BALAYAGE BI
BI TRIGGER BI TIME BASE

5212 460

Fig5

Schlumberger

Référence 5212

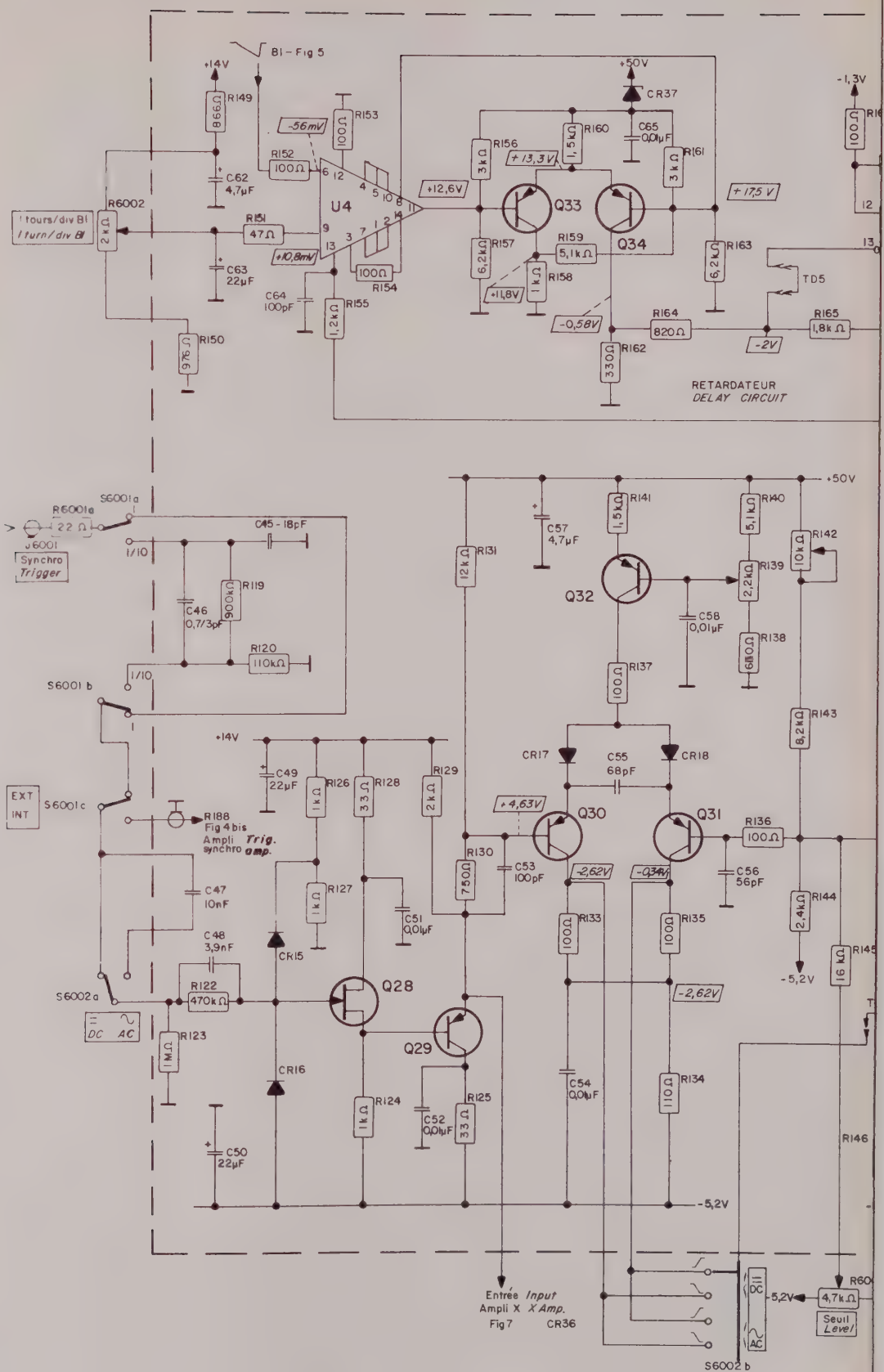
Date

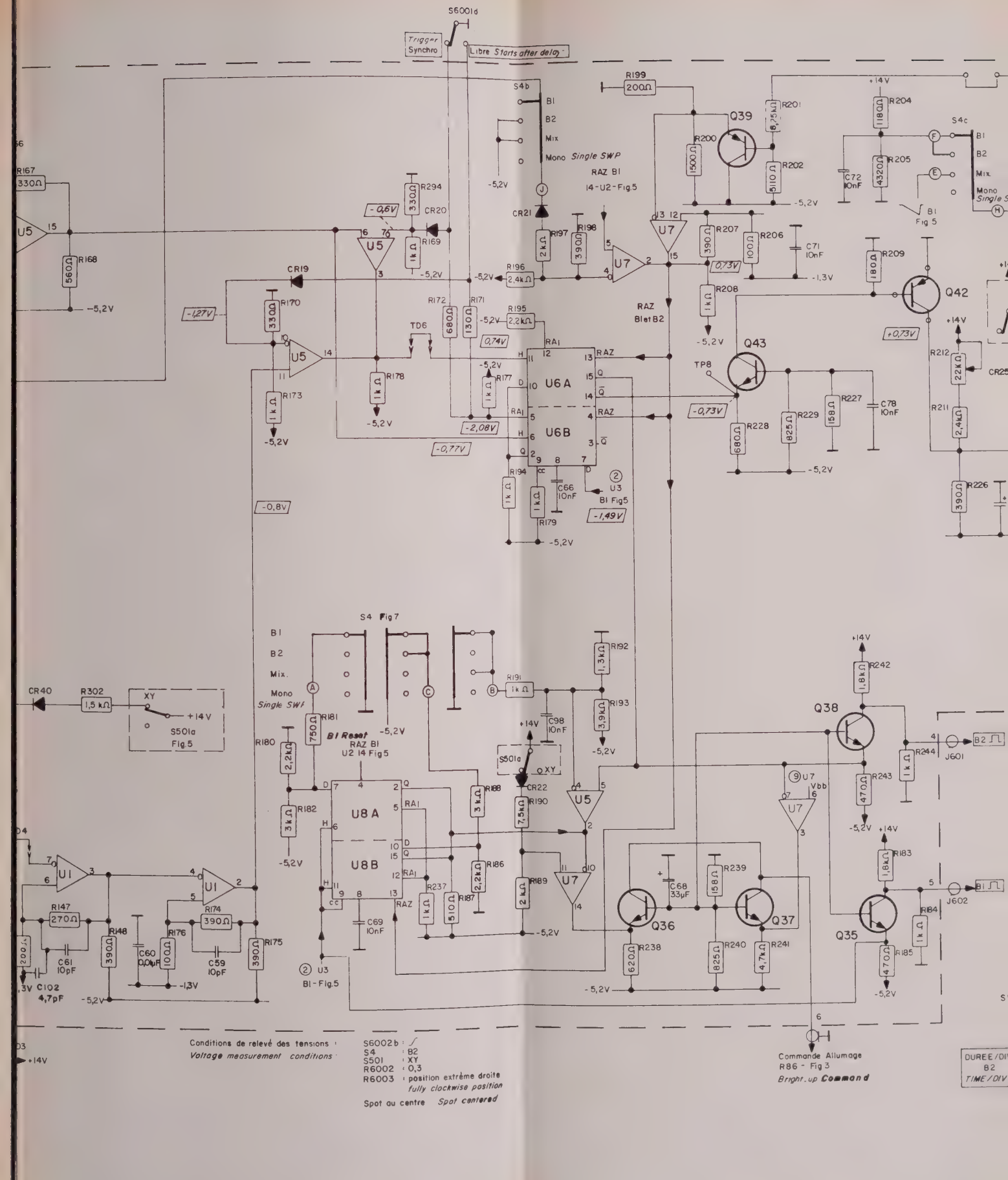
Dessiné par

Commandes exécutées

Cde nº

App. nº


B1 - Fig 5
+14V
R149
866Ω
C62
4,7µF
R6002
2kΩ
1 tours/div B1
1 turn/div B1
R151
47Ω
C63
22µF
R150
976Ω
R153
100Ω
-56mV
R152
100Ω
U4
+10,8mV
100Ω
R154
C64
100pF
R155
1,2kΩ
+50V
CR37
R156
3kΩ
+13,3V
R160
1,5kΩ
C65
0,01µF
R161
3kΩ
+12,6V
Q33
Q34
+17,5V
R157
6,2kΩ
R159
5,1kΩ
R158
1kΩ
+11,8V
-0,58V
R163
6,2kΩ
TD5
R164
820Ω
R165
1,8kΩ
R162
330Ω
-2V
-1,3V
100Ω
RETARDATEUR
DELAY CIRCUIT
S6001a
R6001a
22Ω
S6001
Synchro
Trigger
1/10
C45 - 18pF
C46
0,7/3pF
900kΩ
R119
R120
110kΩ
1/10
S6001 b
EXT
INT
S6001c
+14V
C49
22µF
R126
1kΩ
R128
33Ω
R129
2kΩ
R188
Fig 4 bis
Ampli synchro
Trig. amp.
C47
10nF
C48
3,9nF
R127
1kΩ
C51
0,01µF
CR15
S6002a
R122
470kΩ
DC AC
R123
1MΩ
Q28
Q29
CR16
R124
1kΩ
C52
0,01µF
R125
33Ω
C50
22µF
R131
12kΩ
C57
4,7µF
R141
1,5kΩ
Q32
R140
5,1kΩ
R139
2,2kΩ
R142
10kΩ
C58
0,01µF
R138
680Ω
R137
100Ω
CR17
CR18
C55
68pF
+4,63V
Q30
Q31
R136
100Ω
R130
750Ω
C53
100pF
-2,62V
-0,34V
C56
56pF
R133
100Ω
R135
100Ω
R143
8,2kΩ
R144
2,4kΩ
-5,2V
16kΩ
R145
-2,62V
C54
0,01µF
R134
110Ω
R146
-5,2V
Entrée Input
Ampli X X Amp.
Fig 7 CR36
S6002 b
DC
AC
-5,2V
R60
4,7kΩ
Seuil
Level


S6001d
Trigger Synchro
Libre Starts after delay
S4b
B1
B2
Mix
Mono Single SWP
RAZ B1
14-U2-Fig.5
R199 200Ω
Q39
R200 1500Ω
R201 8,25kΩ
R202 510Ω
-5,2V
+14V
R204 118Ω
R205 432Ω
C72 10nF
S4c
B1
B2
Mix
Mono Single S
B1 Fig 5
R294 330Ω
CR20
CR21
-0,6V
R169 1kΩ
R198 390Ω
R197 2kΩ
U7
R207 390Ω
R206 100Ω
C71 10nF
-1,3V
0,73V
R208 1kΩ
R209 180Ω
Q42
+0,73V
CR19
-1,27V
R170 330Ω
R172 680Ω
R171 130Ω
R195 2,2kΩ
R196 2,4kΩ
TD6
0,74V
RAZ B1 et B2
Q43
TP8
-0,73V
R212 22kΩ
R211 2,4kΩ
CR25
R228 680Ω
R229 825Ω
R227 158Ω
C78 10nF
R226 390Ω
U6A
U6B
R178 1kΩ
R177 1kΩ
R173 1kΩ
R194 1kΩ
R179 1kΩ
C66 10nF
-2,08V
-0,77V
-0,8V
-1,49V
② U3 B1 Fig5
S4 Fig 7
B1
B2
Mix.
Mono Single SWf
R191 1kΩ
R192 1,3kΩ
R193 3,9kΩ
C98 10nF
B1 Reset
RAZ B1 U2 14 Fig5
R180 2,2kΩ
R181 750Ω
R182 3kΩ
U8A
U8B
R188 3kΩ
R190 7,5kΩ
CR22
S501a XY
R186 2,2kΩ
R189 2kΩ
R237 1kΩ
R187 510Ω
C69 10nF
② U3 B1-Fig.5
CR40
R302 1,5kΩ
S501a Fig.5
+14V
R242 1,8kΩ
Q38
R244 1kΩ
J601
B2
R243 470Ω
⑨ U7 Vbb
R183 1,8kΩ
J602
B1
R184 1kΩ
Q35
R185 470Ω
Q36
Q37
C68 33µF
R239 68Ω
R238 620Ω
R240 825Ω
R241 4,7kΩ
U1
R147 270Ω
R148 390Ω
R174 390Ω
R176 100Ω
R175 390Ω
C60 0,01µF
C61 10pF
C59 10pF
C102 4,7pF
-1,3V
-5,2V
Conditions de relevé des tensions :
Voltage measurement conditions
S6002b : /
S4 : B2
S501 : XY
R6002 : 0,3
R6003 : position extrême droite
fully clockwise position
Spot au centre Spot centered
Commande Allumage
R86 - Fig 3
Bright.up Command
DUREE/DIV
B2
TIME/DIV

SYNCHRO B2 BALAYAGE B2

B2 TRIGGER B2 TIME BASE

5212-4606

Fig6

Schlumberger

Référence 5212

Date le 4 Août 75

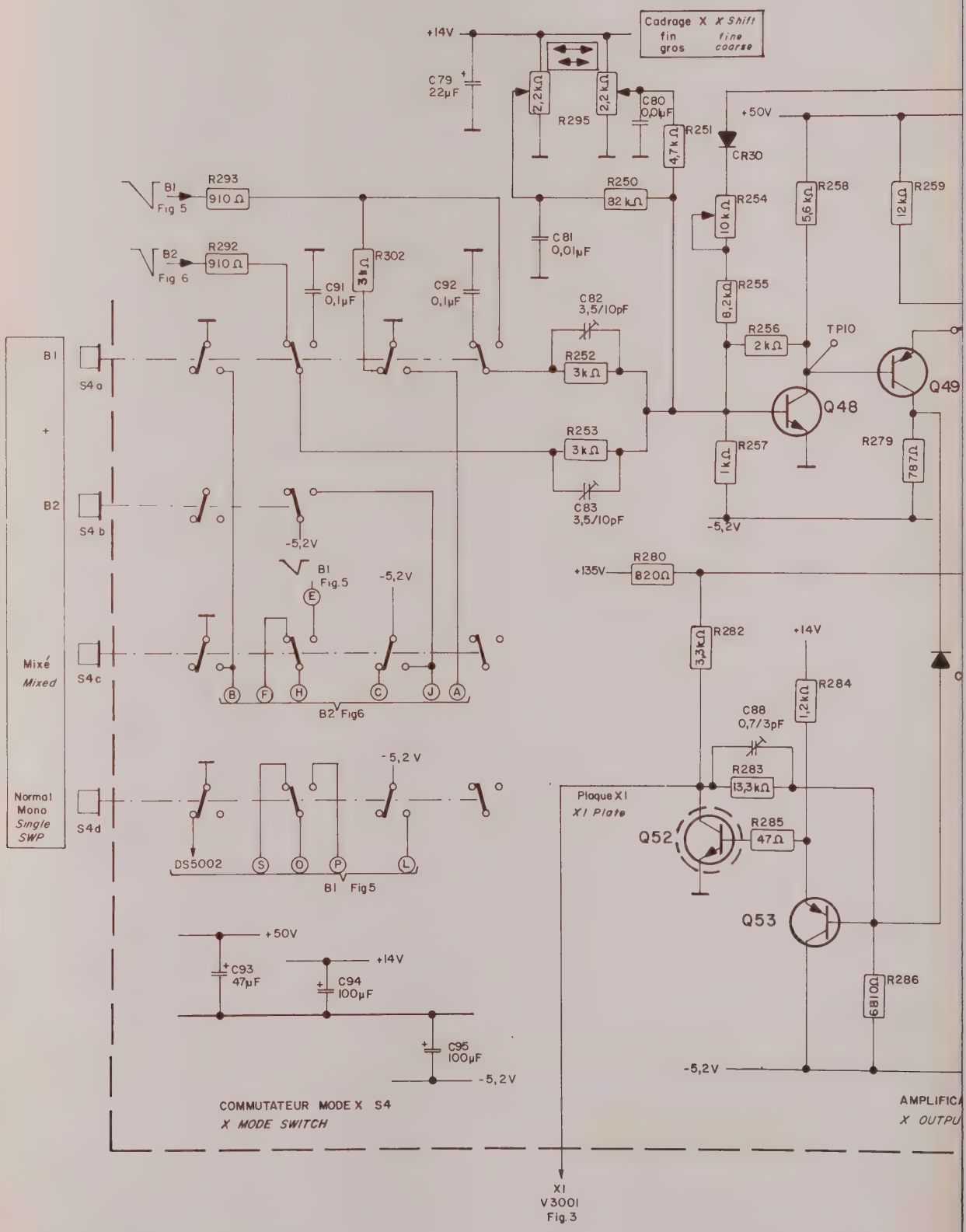
Dessiné par Hugo Bernard

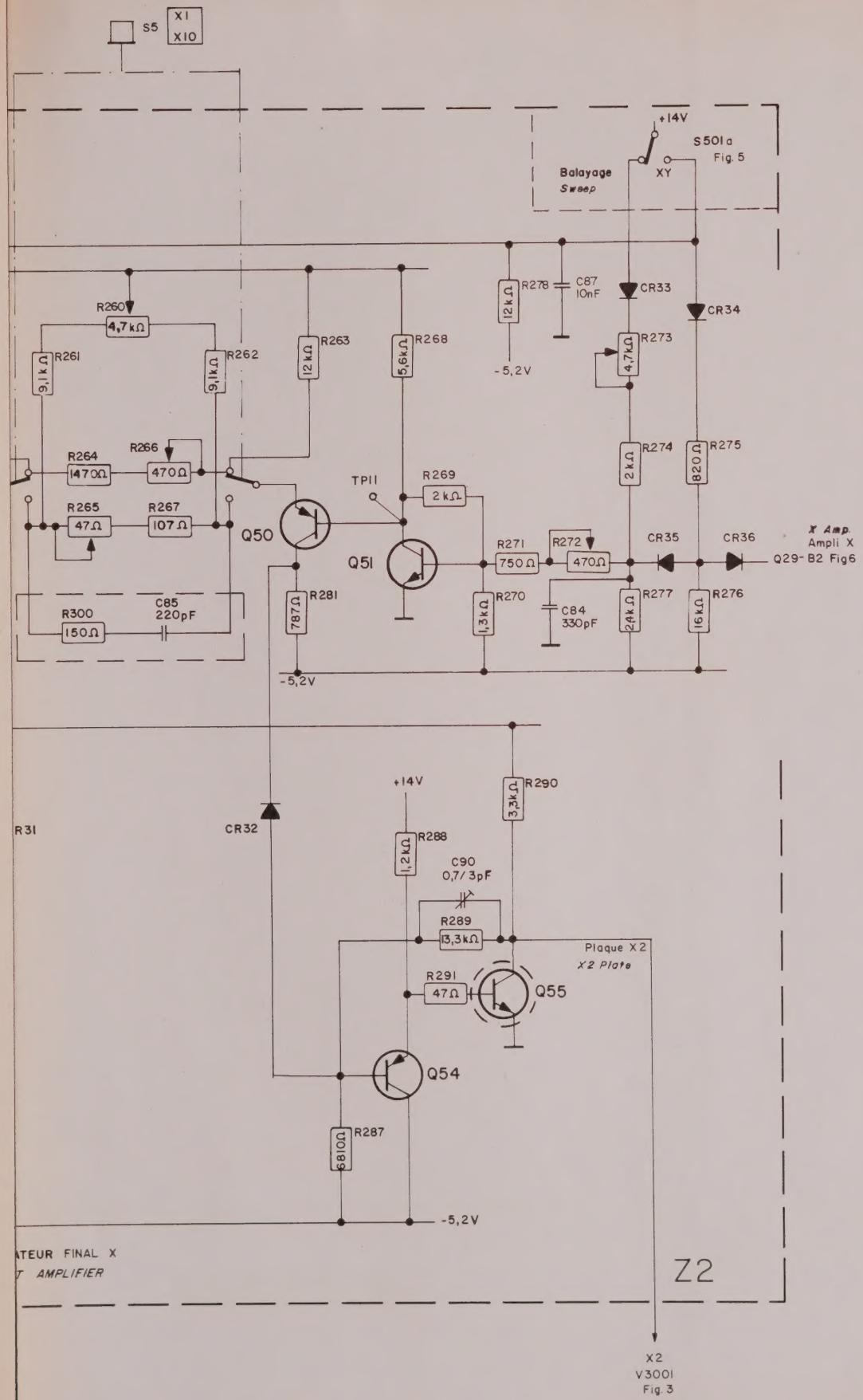
Commandes exécutées

Cde nº

App. nº

Conditions de relevé des tensions : S501a : XY
Voltage measurement conditions : Spot au centre
Spot centered





AMPLIFICATEUR X COMMUTATEUR MODE X
X AMPLIFIER X MODE SWITCH

5212 4607

Fig 7

MP MASTER
MA24230